THE HASHEMITE KINGDOM OF JORDAN
MINISTRY OF PUBLIC WORKS AND HOUSING

E-233 VOL. 2

FEASIBILITY STUDY FOR THE

AMMAN RING ROAD

Volume 2

Environmental Impact Assessment

DAR AL-HANDASAH
Manama Cairo London Beirut

in association with

DAR AL-HANDASAH
Amman

J9760

June 1996

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PHASE 1

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LIST OF ABBREVIATIONS

AADTs	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ABS	Artemesia Brush Steppe
ABY	Abyad
ACE	Associated Consulting Engineers
ACOR	American Centre for Oriental Research
APC	Agricultural Policy Charter
ARR	Amman Ring Road
BAN	Hisban
BIAAH	British Institute at Amman for Archaeology and History
CBOs	Community Base Organization
CLM	Community Liaison Manager
CLOs	Community Liaison Offices
CR	Cultural Resources
CRB	Compensation Review Board
CRIA	Cultural Resources Impact Assessment Report
CRIS	Cultural Resources Impact Statement
CRM	Cultural Resources Management
DAJ	Department of Antiquities of Jordan
DEI	Mudeisis
DH	Desert Highway
DOE	Department of Environment
EA	Environmental Assessment
EEC	European Economic Community
EIA	Environmental Impact Assessment
EIAU	Environmental Impact Assessment Unit
EIB	European Investment Bank
ELO	Environmental Liaison Officer
EPL	Environmental Protection Law
ERC	Environmental Research Centre
EU	European Union
FOA	Friends of Archaeology
GACDP	Greater Amman Comprehensive Development Plan
GCEP	General Corporation for Environment Protection
GDP	Gross Domestic Product
GNP	Gross National Product
GOJ	Government of Jordan
HAT	Qihat
HGV	Heavy Goods Vehicle
HT	High Tension
HTPS	High Tension Pole ...
I/C	Interchange
IFAPO	Institute Francais d'Archelogie du Poche Orient
IPC	Information Participation and Consultation Programme

LIST OF ABBREVIATIONS

IRRs	Internal Rate of Return
IUCN	International Union for the Conservation of Nature
JADIS	Jordanian Antiquities Database System
JD	Jordanian Dinar
JES	Jordan Environmental Society
JHP	Jordan Highlands Plateau
JRV	Jordan Rift Valley
JVA	Jordan Valley Authority
KTR	King Talal Reservoir
LARP	Land Acquisition & Resettlement Plan
LNG	Liquid National Gaz
LPC	Local Planning Committee
MAIA	Ministry of Awqaf and Islamic Affairs
MH	Muwaqqar Highway
MMRAE	Ministry of Municipal and Rural Affairs
MOA	Ministry of Agriculture
MOTA	Ministry of Tourism and Antiquities
MP	Madaba Plain
MPWH	Ministry of Public Works & Housing
MR	Mid Route
MRP	Middle Region Planning
MRPA	Middle Region Planing Authority
NEAP	National Environmental Action Plan
NES	National Environment Strategy
NGO	Non-Governmental Organization
NGOs	Non-Governmental Organizations
NHDP	Northern Highlands Dissected Plateau
NIS	Nisab
NPV	Net Present Value
NRA	National Resources Authority
NSMLUP	National Soils and Land Use Mapping Project
NWMP	National Water Master Plan
OD	Operational Directive
PAP	Project Affected Person
PCC	Project Compensation Committee
PIU	Project Implementation Unit
QAIA	Queen Alia International Airport
RJGC	Royal Jordanian Geographic Centre
ROW	Right of Way
RPC	Regional Planning Committee
RR	Red Route
RSCN	Royal Society for the Conservation of Nature
RSS	Royal Scientific Society
SG	Steppe Grassland
SHB	Sheikh Hussein Bridge
SIS	Mudeisisat

LIST OF ABBREVIATIONS

SPC	Supreme Planning Council
STP	Sewage Treatment Plant
SUF	Sufa
TDS	Total Dissolved Soilds
TER	Truck Escape Ramp
TOR	Terms of Reference
TSP	Total Suspended Particles
UK	United Kingdom
UNDP	United Nations Development Programme
USA	United States of America
USAID	United States Aid
WAJ	Water Authority of Jordan
WB	World Bank
WHO	World Health Organization
YAD	Yaduda
ZEBP	Zarqa Eastern By-Pass
ZTR	Zarqa Through Route

EA PROJECT TEAM

This EA has been prepared by Dar Al Handasah Consultants (Shair and Partners) in accordance with the contract award by the MPWH in August 1997.

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SECTION 1:

INTRODUCTION

SECTION 1: INTRODUCTION

1.1 PROJECT BACKGROUND

The population of Jordan is now estimated at 4.1 million and is growing rapidly. Over the period 1979 -1994 natural growth averaged 3.4% per annum. and total growth, some 4.35%. Most of this population live in cities. Urban areas now accommodate some 77% of the total population, with the Amman Zarqa urban agglomeration alone, accounting for 55%, or 2.2 million.

This area is the major commercial and industrial centre of the country, (80% of National employment in the Industrial sector is located within it). In addition, the region is a focal point for international transit trade which plays a major role in National economic activity and growth, at present, and which in the future is likely to develop further as opportunities arise from the moves towards Regional integration and the increased liberalisation of trade.

In this context, as part of the ever increasing transport sector development, and in view of the potential for rapid growth in the economy, the Government of Jordan, through the Ministry of Public Works and Housing (MPWH) have commissioned a study to assess the feasibility of an Amman Ring Road (ARR).

The provision of an ARR has been a long-standing policy objective of the Government and it has been the subject of several engineering and economic studies over the last two decades. The present study, initiated by the MPWH with the assistance of the World Bank, builds upon these earlier works and will provide a comprehensive and detailed assessment of the project.

1.2 STUDY COMPONENTS

The Study is divided into two separate phases, a Prefeasibility Study for the entire ARR and a Feasibility Study for the Initial Sections (Phase 1).

The Prefeasibility Report was completed in January 1998. The reporting for that stage comprised four volumes

Volume 1: Technical Economic and Financial Evaluation
Volume 2: Environmental Assessment
Volume 3: Supporting Socio-Environmental Studies
Volume 4: Moderators Report on the Scoping Sessions.

Subsequent to that submission an Addendum Report has been prepared to investigate further the opportunities for new alignments of southern sections of the road.

This, the Feasibility Stage of the project is restricted to Sections 1 and 2, between Zarqa and the Desert Highway and shall be reported on in seven volumes.

Executive Summary
Summary Environmental Impact Assessment
Volume 1: Technical Economic and Financial Evaluation
Volume 2: Environmental Impact Assessment

Volume 3: Resettlement Action Plan
Volume 4: Cultural Resources Impact Assessment
Volume 5: Review of Public Consultation Programme

1.3 REPORT SCOPE

Initial Screening classified the project as a Category A, under the World Bank system, i.e. requiring a full Environmental Assessment (EA). The Project is therefore anticipated to have significant impacts on the human and natural environment, and will affect a wide spectrum of stakeholders.

This report seeks to identify probable Project impacts, their significance and the community affected and to develop a Mitigation programme that will both minimise defined adverse effects and, also maximise potential positive impacts.

It should be noted that this Report (and the other Reports) have been prepared on the basis of preliminary engineering drawings and in some cases detailed studies initially intended to be undertaken for the preferred alignment at this stage of the Study have been deferred until a subsequent Detailed Design Phase scheduled to be carried out after Project Appraisal.

It is therefore possible that the final selected alignment will vary from that established or that that defined is in fact incorrect. While such variations are unlikely to affect the overall quantum of impacts they may result in local variations to the data presented here.

1.4 REPORT STRUCTURE

This Report has a structure typical of a World Bank (WB) EA. The following Section 2 contains a short review of the Project, outlining its development, present status and proponent.

Section 3 comprises an overview of the National, Institutional and Legislative framework within which the project is being developed and within which this Report is prepared.

The Baseline Conditions of the study area are addressed in two Sections, 4 and 5 which deal with the Biophysical Environment, and Socio Economic Context, respectively. The data provided in these sections is presented in both local and regional contexts as required.

Sections 6 to 9 comprise the Project Impact Statement. Section 6 contains a brief overview of possible impacts related to construction activities, on and off site while Section 7 defines the permanent effects of the actual construction of the road, land acquisition, property take, production loss severance and such like.

Section 8 details the likely extent and magnitude of impacts related to the operation of the road. This includes assessments of noise and vibration, air quality impacts, accidents and water pollution. The final Section of the Impact Statement, Section 9 deals with the indirect impacts of the project, specifically the issues related to induced development.

This is supplemented in Section 10 by a brief overview of the rationale or need for the project and thereafter, a summary description of Project Alternatives.

The Mitigation Plan is outlined in Section 11 under five broad headings:

- Temporary On Site
- Temporary Off site
- Permanent On Site
- Operations
- Indirect Impacts.

Section 12, outlines the proposed monitoring and implementation programme for the Mitigation Plan. This includes the definition of the works to be undertaken, the timing of those works and the allocation of responsibilities. Proposals for institutional strengthening are also put forward.

The final Section 13 provides an overview of the Information and Consultation programme undertaken to date on the Project.

This Report does not address, except in brief, a number of other key elements of the TOR and the Project EA process, specifically:

- Land Acquisition and Resettlement Studies
- Cultural Resources Impact

This text is supported by a separate Volume of Appendices, A to R that provide further supporting detail and background.

SECTION 2:

PROJECT BACKGROUND AND PROJECT DESCRIPTION

SECTION 2: PROJECT BACKGROUND AND PROJECT DESCRIPTION

2.1 INTRODUCTION

This Section contains five further sub sections. Sections 2.2 to 2.4 provide some background to the Amman Ring Road Project (ARR) defining its present development status, physical location and identifying the project proponent.

Section 2.5 provides a description of each of the five principal Project components that are to be subject to EA. This description includes a statement of the status of the project design and the possible implications therein on the works contained in this EA.

The final section, Section 2.6, contains the design guidelines established for the project.

2.2 PROJECT STATUS

2.2.1 Past Studies

The Amman Ring Road Project was initially studied and designed in the period 1983-87 by Associated Consulting Engineers (ACE). At that time a number of different alignments and routing options were considered and a final alignment comprising the five segments listed in Table 2.1 and shown in Figure 2.1, selected.

However, the costs of that project, especially in land acquisition and resettlement, were such that its implementation was deferred.

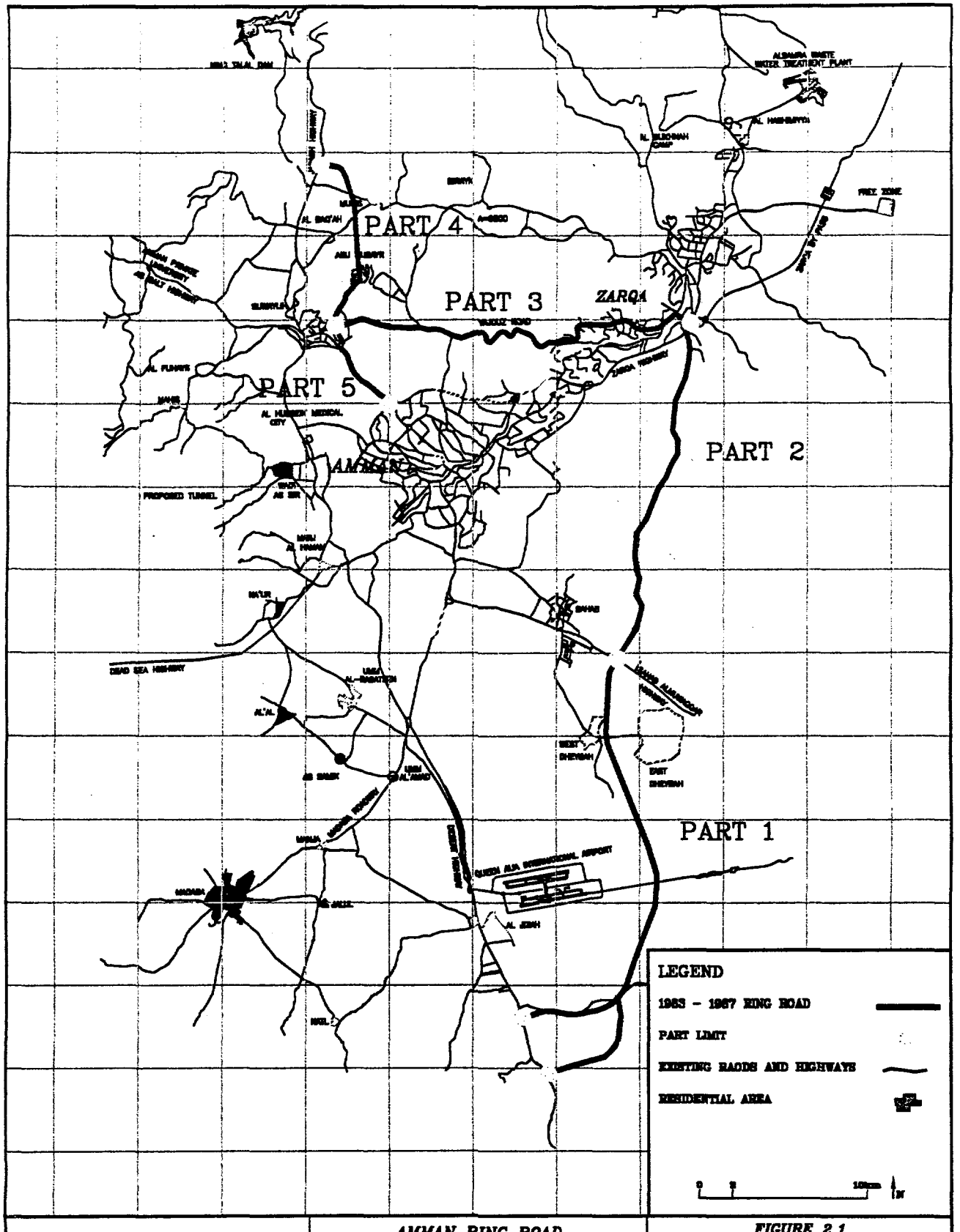
Table 2.1 Sections of Original Ring Road Project

Section	From - To	Length (km)
1	Al Jiza / Sahab - Muwaqqar intersection	27.407
2	Sahab - Muwaqqar intersection / Zarqa by pass	21.155
3	Zarqa bypass / Yahoos, Al Jubeeha and Abu Nuseer Intersection	22.196
4	Yahoos, Al Jubeeha and Abu Nuseer Intersection / Al Jea'dya Intersection	15.000
5	Yahoos, Al Jubeeha and Abu Nuseer Intersection / Halawa Intersection	5.500

Source: Consolidated Consultants, 1996

The project was revisited in 1989 under a study by Ruqn Al-Handasah that contained economic and environmental assessments of the Eastern and Northern Sections of the road using standard UK Department of Transport, COBA type, analysis.

While these reports again found the project to be economically attractive, (Table 2.2) no further action was taken.



DAR AL-HANDASAH

AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 2.1
PREVIOUS RING ROAD OPTION
1983 - 1987

Table 2.2 Summary Table of Economic Results: Ruqn Al-Handasah Study 1989

Option No.	Length (kms)	Cost (JD mill)		IRR (%)	NPV (JD mill)	Period of Return
		1989	1998			
1	28.8	9.789		41.5	25.622	5
2	22.7	9.078		60.5	33.504	5
3	53.7	19.687		59.5	96.447	4
4	37.2	18.123		29.5	23.487	7
5	96.7	40.023		28.5	54.545	8
6	20.3	12.877		50.5	44.554	4

Note: 1989 JD1 = $US . IRR and NPV based on 1989 JD value and are reproduced from RAH report.

Source: Ruqn Al-Handasah, 1989

In 1996, the MPWH reactivated the project. However it was considered that the problems of cost associated with Sections 3, 4 and 5 associated with the original (1983-87) proposal would have been magnified significantly in the intervening period, to the extent that those Sections would no longer be viable.

Accordingly, the works commissioned by MPWH under Central Tender No. 197/ 95 were as follows:

- Design Studies for Sections 1 and 2.

- New studies (to a reconnaissance level) of alternative alignments for Sections to ring Amman (anticlockwise) from Zarqa to the Desert Highway interchange with Section1.

Documentation for the studies provided under this contract included:

Design Studies	**Reconnaissance Study**
• Design criteria and controls • Description of the alignment and right of way • Intersection design • Hydrological study • Interchange bridges and other structure layouts • Bills of quantity and cost estimates • Recommendations	• Identification of feasible routes • Design criteria and controls • Hydrological study • Geological / Geotechnical investigations • Cost estimate • Recommendations

The results of these studies were reported in the following documents:

- Final Report Amman Outer Ring Road (Part A), July 1997.
- Final Report Amman Outer Ring Road (Parts B and B'), August 1997
- Final Reconnaissance Report, Remaining Part of Amman Ring Road, June 1997

In addition, and since the signing of this contract, MPWH commissioned further works on the development of alternative corridor options and alignment alternatives that were to be subject to Prefeasibility assessment.
The findings of these additional studies were recorded in a series of maps provided to the MPWH and the Consultants in both hard and soft copy form, supplemented by a summary report.

2.2.2 Present Study

The present study, initiated by the MPWH with the assistance of the World Bank, builds upon these earlier works and is intended to provide the following works:

(i) Prefeasibility Assessment, Environmental Scoping and Preliminary EA: For **all sections** of the ARR. (Completed and reports submitted in January 1998).

(ii) Full feasibility study and a Category A EIA. **For Sections 1 and 2**

This Report complies in part with the requirements of (ii) above.

2.3 PROJECT LOCATION

2.3.1 General

As shown in Figure 2.2, the project corridor lies at distances varying from 10 to 25 km to east and south of Amman city centre, far enough to include within its boundaries major suburban population centres such as Sahab and to provide direct linkages to Zarqa.

The corridor also intersects with the National highways that link Amman and Zarqa with the rest of the Kingdom. International traffic using Highway 15 (linking the Syrian and Saudi borders) and Highway 40 (linking the Palestinian and Iraqi borders) will be able to use the ARR to avoid passing through Greater Amman or Zarqa.

2.3.2 Administrative Boundaries

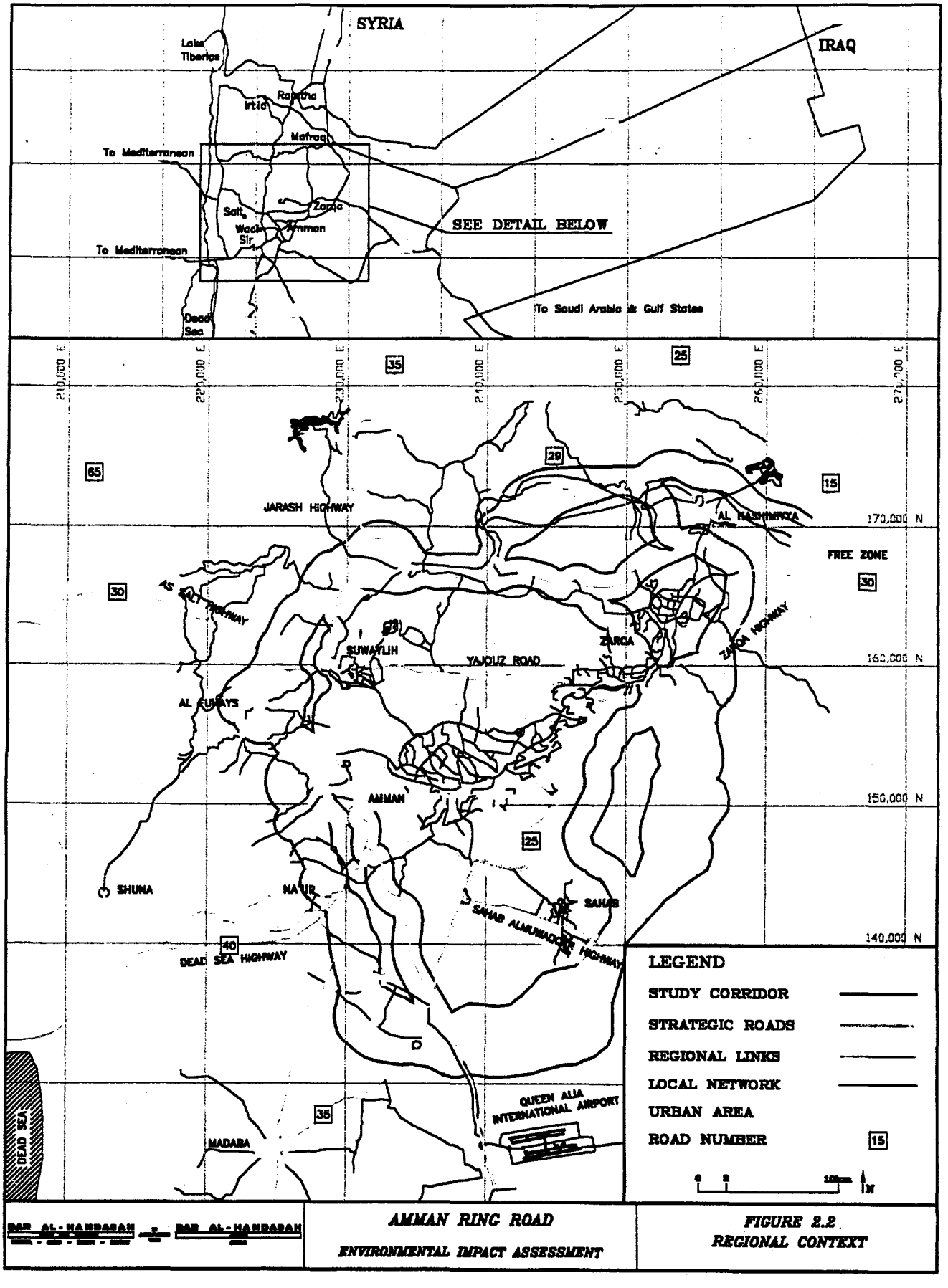
The Project lies within a number of defined administrative boundaries, (Figure 2.3). Specifically,

Zarqa Governorate

- Zarqa District
- Russeifa District

Amman Governorate

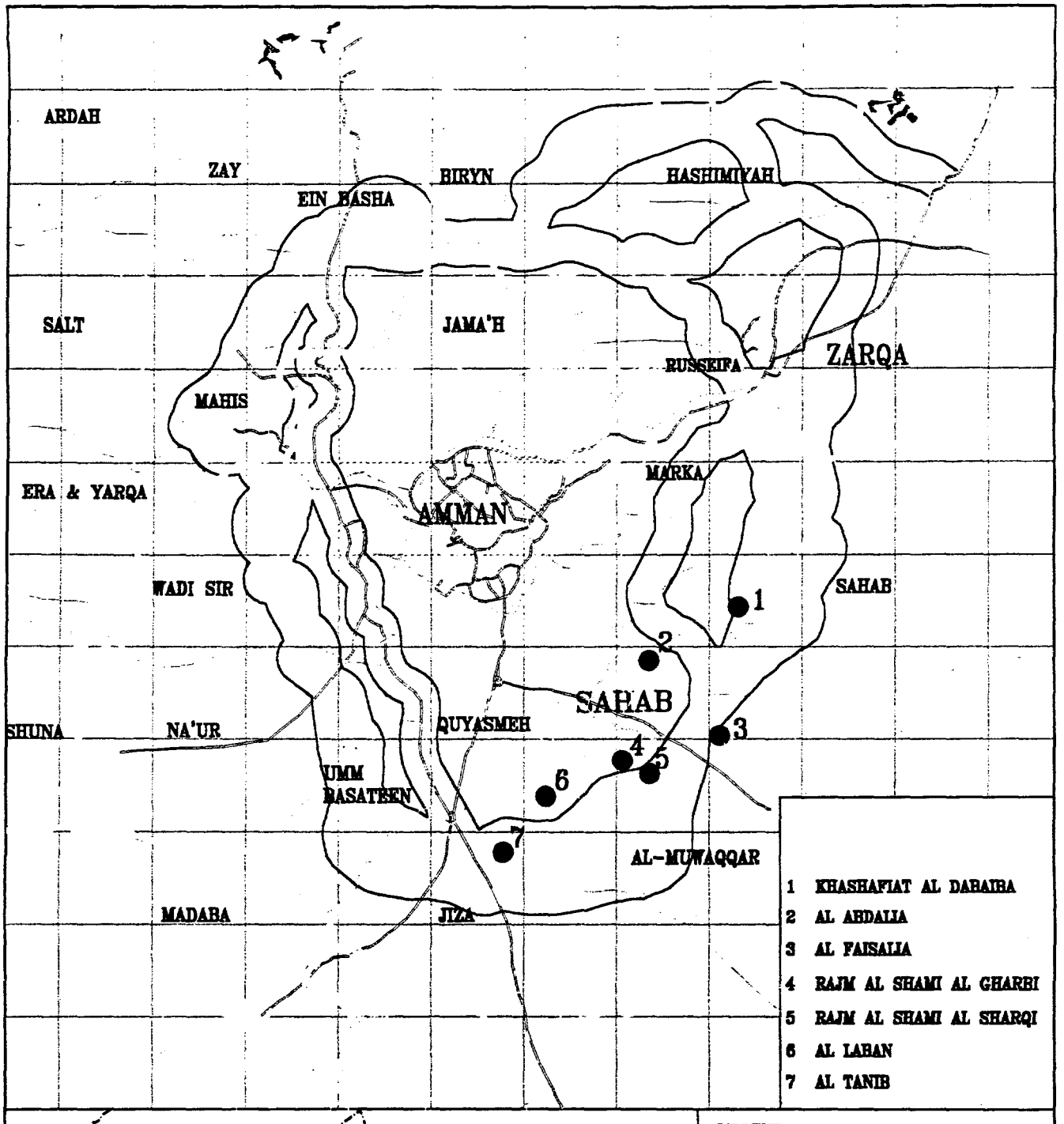
- Marka District
- Sahab District
- Muwaqqar District
- Jizah District

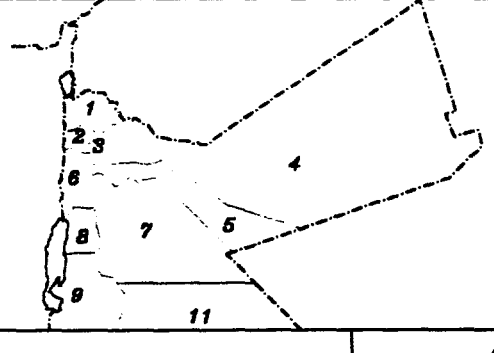


AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 2.2
REGIONAL CONTEXT





GOVERNORATES

1 *IRBID*
2 *AJLUN*
3 *JERASH*
4 *MAFRAQ*
5 *ZARQA*
6 *BALQA*
7 *AMMAN (CAPITAL)*
8 *MADABA*
9 *KARAK*
10 *TAFILAH*
11 *MA'AN*

LEGEND

ALIGNMENT CORRIDOR
GOVERNORATE BOUNDARY
DISTRICT BOUNDARY
AFFECTED COMMUNITY

AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 2.3
ADMINISTRATIVE BOUNDARIES

In addition to these local authorities there are a number of central government agencies that have responsibilities that cross administrative boundaries. The concerns associated with potential duplication and overlap are addressed in more detail in the review of the Project Implementation Framework in Section 3.

2.4 PROJECT PROPONENT

The project proponent is the Ministry of Public Works and Housing, whose contact address is as follows:

Ministry of Public Works and Housing
P.O Box 1220
Amman
Hashemite Kingdom of Jordan

2.5 PROJECT DESCRIPTION

The 5 highway elements of Phase 1 of the Project can be found in Figure 2.4

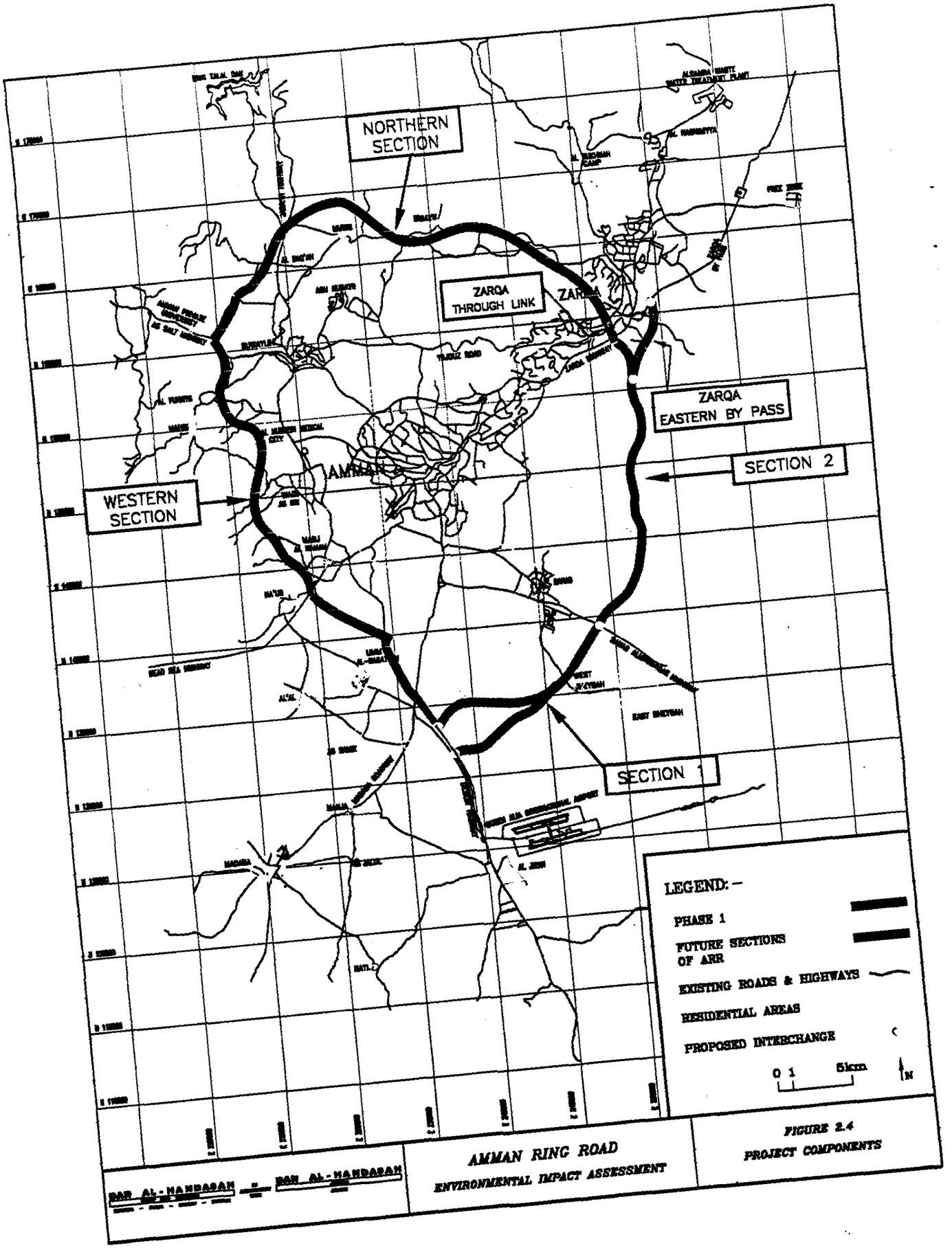
2.5.1 Section 1 Red Route: Desert Highway to Al Muwaqqar Road (km 1+000 to km 24+250)

This section is located in open flat agricultural terrain with little physical constraint. Design geometry is of a high standard comprising flat gradients and large radius horizontal curves. Embankment heights are governed by drainage provision. They generally average 1.5m to 2.5m above ground level.

The proposal commences with a semi-directional three leg interchange at the Desert Highway. This junction will be designed to high standard allowing fast interchange between roads in each direction. Radii used for ramps are in the range 300m-350m with two-lane provision being applied throughout. The entire interchange is located on embankment in a flat open agricultural area having the two left turn ramps rising 7.5m in embankment over the Desert Highway and then crossing each other at a skewed grade separation some 120m west of the Desert Highway. The interchange will be constructed with service road provision and will take up about 36 hectares of land.

The two lane dual carriageway alignment runs north-eastwards within a 60m Right of Way in open unconstrained agricultural land on low embankment. Box and pipe culverts are provided at low points generally defined by shallow wadis. The alignment rises above the railway line locally at km 4+800 where a bridge is proposed together with two small underpasses for road access.

The alignment continues north-eastwards in generally flat terrain having a localised shallow cut section between km 6+200 to 6+560 and some small wadi diversion works around km 7+500 with an local road underpass at km 7+840 in combination with a large box culvert crossing.


NORTHERN SECTION
ZARQA THROUGH LINK
ZARQA EASTERN BY PASS
SECTION 2
WESTERN SECTION
SECTION 1
AMMAN
ZARQA
LEGEND:-
PHASE 1
FUTURE SECTIONS OF ARR
EXISTING ROADS & HIGHWAYS
RESIDENTIAL AREAS
PROPOSED INTERCHANGE
0 1 5km
N
BAR AL-HANDASAH
BAR AL-HANDASAH
AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT
FIGURE 2.4
PROJECT COMPONENTS

The alignment continues on embankment to cross the Deybah Road at km 10+440. At this location it is proposed that the Deybah Road is bridged over the ARR. Based on traffic predictions an interchange connection here is not necessary in the short to medium term. Some localised wadi channel diversion however is required at his point.

The alignment continues north-eastwards towards Al Muwaqqar Road. The ARR mainline rises up and over the existing Al Muwaqqar Road which is located in local cutting, before continuing north-eastwards again towards the more hilly areas of Section 2. The proposed connection with Al Muwaqqar road is via a full cloverleaf interchange. The Al Muwaqqar Road will require widening for this interchange and a land area of about 24 Hectare would be needed for the entire facility.

2.5.2 Section 1 Mid Alternative

Mid Alternative 2D and SSR 3A – Desert Highway to Al Muwaqqar Interchange- 2D (km 0+000 to km 4+660) plus 3A (km 15+080 to km 23+195)

The first 3.0km of this section passes through either cultivated or subdivided land containing scattered development of villas or houses and passes to the north of a village community at Tanib. Apart from this first 3.0km, the alignment is generally located in open flat agricultural terrain with little physical constraint. Design geometry is of high standard comprising flat gradients and large radius horizontal curves. Drainage provision governs embankment heights and is on average about 1.0m to 2.0m above natural ground level.

The proposal commences with a semi-directional three leg interchange at the Desert Highway immediately north of the Al Isra'a University. This junction will be designed to high standards allowing fast interchange in each direction. Radii used for ramps are in the range 300m-350m with two-lane provision being applied throughout. The entire interchange is located on embankment in a rolling/wadi open area having the two left turn ramps rising 7.5m in embankment over the Desert Highway and then crossing each other at a very skewed grade separation some 150m west of the Desert Highway. The interchange will be constructed with limited service road provision and will take up about 40Ha.of land. Fill heights for the interchange will be higher than would occur in normal flat terrain. This is because a major wadi runs through the area resulting in low natural ground levels at critical bridge crossing points in the layout. Drainage requirements in the interchange area are also in excess of those normally expected.

From the interchange, the alignment runs north-eastwards between areas of land parcellation which contain road infrastructure. The alignment climbs slowly heading towards a shallow saddle in a ridge linking Tanib Village and the University. Between km 2+000 and km 2+700 the alignment is formed in 7.5m of cutting (maximum) over which an overpass is provided for the existing Tanib Road. The alignment continues directly eastwards, skirting to the north west of Tanib Village to emerge open flat to gently rolling terrain at km 3+500. An overbridge is proposed at km 3+000 to maintain continuity in the local road network. The end of the Mid Alignment 2D is 250m in advance (to the west) of the railway crossing. Drainage requirements over this section of mainline are minimal.

From this point Alignment 3A continues eastwards to cross above the railway in box structure at km 15+350 and pass between isolated farm developments and to the west of localised high areas at km 16+000 and km 18+500. Several drainage culverts are required over this length although the main wadi is not encountered until the area of Deybah Road crossing.

2.5.3 Section 2: Muwaqqar Road to Zarqa Highway

Red Route Section 2b - Al Muwaqqar Road to Wadi Ush (km 1+000 to km 15+200)

This section of the ARR is located in predominantly open land and comprises mostly of marginal, rainfed agricultural lands or uncultivable rangelands supporting a few village communities. The road geometry is generally good but some difficult mountainous areas have required the lowering of standards, particularly vertical alignments. Cut and fill sections are quite large in some areas and a fair proportion of the route is in difficult sidelong ground. Drainage requirements, being consistent with the terrain type, are fairly substantial.

From the Al Muwaqqar Road, the alignment runs north-eastwards for about 1.3km before it enters hilly/mountainous terrain requiring gradients of almost 6% and cuts and fills of 14m and 8m respectively. At km 2+080 the alignment reaches the highest point of 895m following a continuous climb from km 0+800. At km 3+440 the alignment rapidly drops down from the top undulating section of the hills at a gradient of 6.4%.

The alignment continues in flat to rolling terrain from km 3+880 in the ridge foothills cutting through a large knoll at km 4+560 and continuing in flat gradient towards the village of Manakher. Embankment heights are at 4m to 6m in this area and the existing Manakher Road is provided with an underpass at km 5+640.

The proposed ARR continues northwards skirting Manakher Village at km 5+900 and heading into rolling to hilly agricultural land. Horizontal and vertical alignments are quite good over this section with cuts and fills generally reaching between 2m to 4m although is some cases they 6m.

The alignment begins to climb again into difficult hilly to mountainous terrain at km 9+000 encountering large cuts and fills of up to 14m to 16m with gradients of 3.5% to 4.5 %. The alignment reaches the second highest point of 829.5m at km 10+600 and from that point the alignment drops in sidelong ground via valleys and saddle formations towards Wadi Ush. Earthworks will be quite extensive and in some cases quite difficult, especially deep cuts in sidelong ground. From km 13+160 to km 14+000 is particularly difficult having a gradient of 6.5% and a 450m horizontal curve at the bottom of the gradient. A very large height of embankment (12m to 18m) is required on entry to Wadi Ush from which the alignment is then placed to hug the southern side of the Wadi valley.

Red Route Section 2b' - Wadi Ush to Zarqa Highway (km 0+000 to km 5+060)

This alignment is about 5km long and is located in its entirety on the southern side of Wadi Ush initially high on the valley side and latterly closer to the Wadi Ush flood levels on the approach to Zarqa Highway. The horizontal alignment commonly uses the smallest radius consistent with a design speed of 100km/h and generally has fairly flat vertical alignment.

From the start of the route at Wadi Ush, the vertical alignment remains high up the side of the valley to avoid some industrial and other commercial development before dropping down at 5% to run closer to the wadi bed alignment and level. A series of cuts and fills in sidelong ground are required with drainage pipes or culverts being necessary at regular intervals along the alignment. Some small sections (a couple of hundred metres) pass through cultivated land, however the predominant land use on the southern bank is open/unused.

At some locations wadi protection may be required on embankments which slip over into the wadi bed, alternatively in some cases it may be more appropriate to construct low level retaining walls.

On the immediate approach to the Zarqa Highway, at km 4+700 the alignment cuts through a localised high area before rising in 10m of embankment to pass over the Zarqa Highway where a cloverleaf interchange is proposed.

2.5.4 Zarqa Through Route

Prior to investigating the preliminary engineering aspects of the section between Zarqa Highway and the Yajouz Road, (approximately the first 2.5 kms), it was first confirmed that the route extension beyond Km 2.5 was viable. This was done by producing plans and profiles for the remaining sections of 'through' Route at small scale.

The first stage proposed for the ARR Phase 1, to the Yajouz Road will provide an interim 'Ring Road' configuration for northern Amman prior to construction of the link to Birayn and further.

Preliminary designs have been prepared in accordance with AASHTO standards and prevailing practices in Jordan. However, the following features should be noted:

(i) The design speed of the mainline is assumed to be 90 km/h.

(ii) A loop ramp in Zarqa Highway Cloverleaf (Ramp 7 quadrant) has been omitted since traffic demand is small and provision of the loop would require demolition of new, high quality villas.

(iii It is assumed that buildings within the Zarqa Highway Cloverleaf quadrant (Ramp 7) would be removed.

(iv) The Seil Zarqa viaduct is unsuitable for construction using beam (25m span) and slab decks. A more cost effective and aesthetically pleasing concept would be to use a deeper deck with longer spans. It is tentatively proposed that a concrete box girder construction be adopted using incremental launching. In view of this, four 35.40m spans are suggested, giving an overall viaduct length of 140m. Cost estimates have been based on this premise.

(v) It should be noted that there is no major property demolition required between Zarqa Highway I/C and the Seil Zarqa.

(vi) Retaining walls will be necessary on the approach to Zarqa Old Road. Since the walls will be very high, and will require splaying out to accommodate ramp tapers, it is proposed that reinforced earth walls should be adopted. These can be built in a single vertical lift to a maximum of 25.0m height. Since the height of the Ring Road walls will be 15.0m, this can be easily accomplished in a single vertical wall. Further detailed design provides the opportunity to refine this proposal to possibly 'tier' the walls and to landscape them appropriately. This would help to reduce the visual impact of this construction.

(vii) The alignment passes above the Old Zarqa Road on a structure which also bridges a railway line. This structure will be of beam and slab construction, but nevertheless will be expensive. This is because of the irregular shape of the deck which accommodates the railway and Ring Road ramp widenings.

(iii) The proposed ramp connections to Yajouz Road join that road at unsuitable longitudinal gradients of 6-8 percent. At the next stage of design, it may be possible to realign the Yajouz Road vertically to improve the situation. Major widening of the Yajouz Road will be necessary to accommodate the signal controlled intersections. It is anticipated that road widening can be effected over the two horizontal curves either side of the junction area.

2.5.5 Zarqa Eastern By Pass

This route commences at some 2.7 km from the Zarqa Highway just in advance of a cultivated area on the west bank of Wadi Ush. The ZEBP alignment turns directly eastwards crossing over Wadi Ush at high level, avoiding HT electricity lines to climb steeply up via deep cuts and fills to the mountainous areas directly behind (south-east) of the industrial area. The horizontal and vertical alignments are severely constrained by the topography over the first 2.5km rising at 4% to 5% and descending at 5% to 6%.

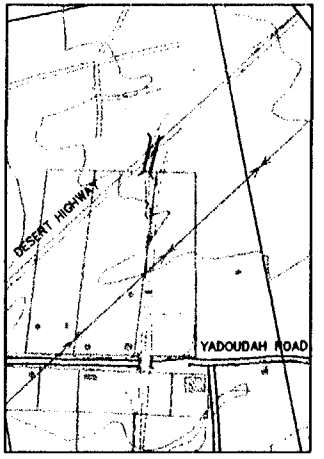
The alignment drops down steeply in open land around the periphery of a newly planted forest area, heading north and then northeast towards the western side of the military residential area. The alignment runs over hilly open ground passing firstly over a wadi and then the Military College Road to turn left beneath HT lines and around another fenced military area. The alignment continues north-westwards in hilly open ground towards the Zarqa By-Pass to which it connects with a directional interchange.

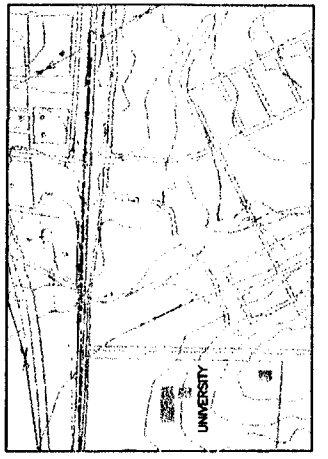
2.5.6 Interchanges

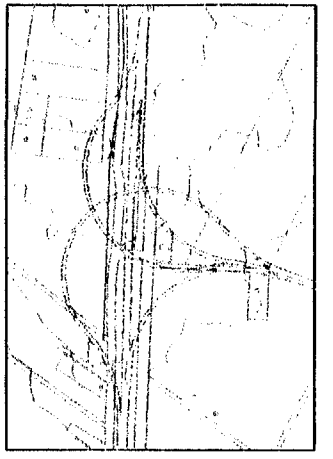
Desert Highway

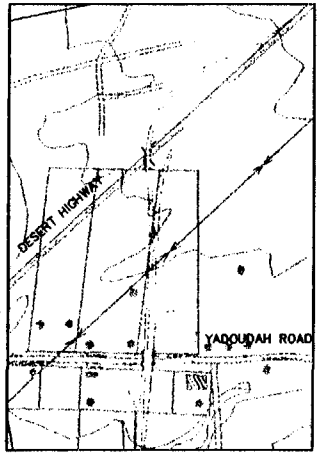
Of the three locations identified the minimum provision to satisfy traffic demand is indicated in Figure 2.5.

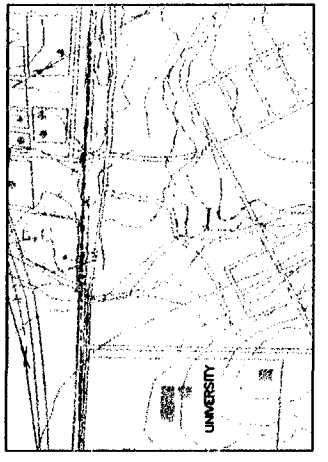
In the case of the Northern Alternative 2C, a directional connection with the existing Desert Highway and a partial connection with Yadoudah Road is proposed. Because of the heavy movement from, and to the south on the Desert Highway to Yadoudah Road in the Amman direction, improvements to Madaba Interchange will be necessary.

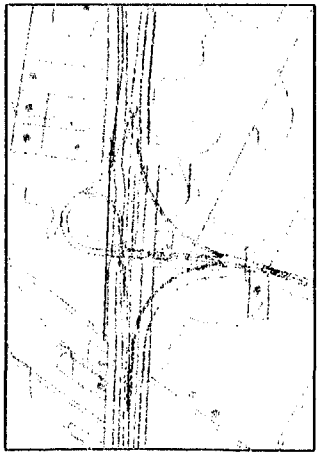












SSR

MID ROUTE

RED ROUTE

DAR AL-HANDASAH — DAR AL-HANDASAH

AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 2.5
DESERT HIGHWAY INTERCHANGE OPTIONS

It should be noted that these improvements to Madaba I/C would be required in the medium term irrespective of the influence of the ARR.

The minimum requirements for the Mid-Alternative 2D and the Red Route would be a trumpet type of configuration as shown in 2.5. The loop ramps are orientated so that there is a semblance of continuity on the ARR and the shared section of Desert Highway. This however, is contradictory to traffic demands which are slightly heavier in the loop ramp direction (Aqaba to Zarqa and vice versa). In both cases, single lane ramp configurations would be adequate in terms of theoretical traffic capacity to 2023.

Other higher order alternatives for I/C configuration were investigated at each I/C site. No further choices could be identified north of Madaba I/C and so the original proposal was retained as the only realistic/practical option available.

For the Mid Route Alternative 2D and the Red Route, fully directional interchanges were considered but ruled out because of the relatively low traffic demand, high cost and high impact in terms of land and property take.

Investigations into semi-directional concepts revealed that suitable configurations could be designed as shown in Figure 2.5. Radii are in the region 300m to 400m, however further (more detailed) preliminary design work could increase the minimum radius to 325m or 350m. It is unlikely, however, that the design speeds on all the semi-direct ramps would reach the full mainline speed of 100 km/h. It appears that an operational (posted) speed for the semi-direct interchanges would be 80 to 90 km/h.

Muwaqqar Highway and Zarqa Highway

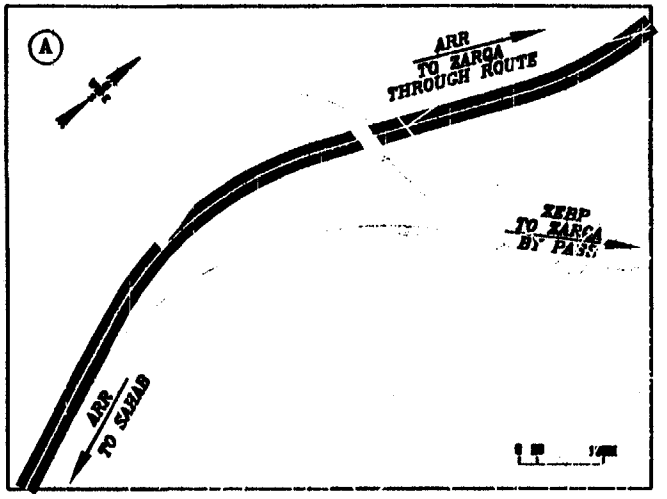
The Muwaqqar interchange is identified as a full clover leaf with the ARR mainline passing over the existing Highway. The ZTR / Zarqa Highway interchange has only ramps in only 3 quadrants reflecting a combination of low projected turning movements and a desire to limit property take to a minimum.

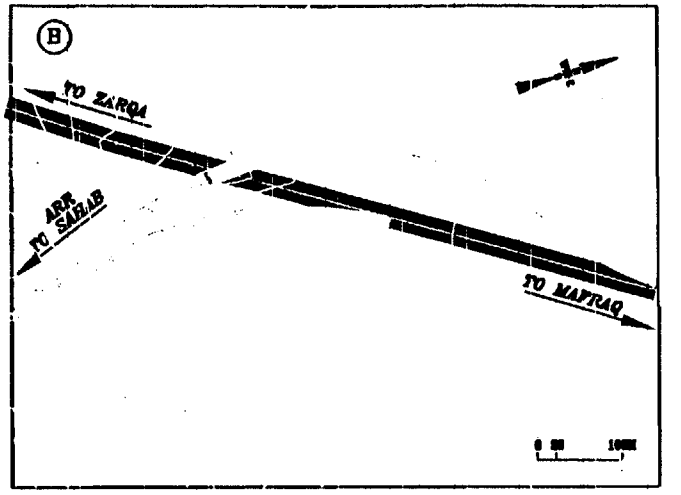
Section 2 Directional with ZEBP and ZEBP and Zarqa By Pass

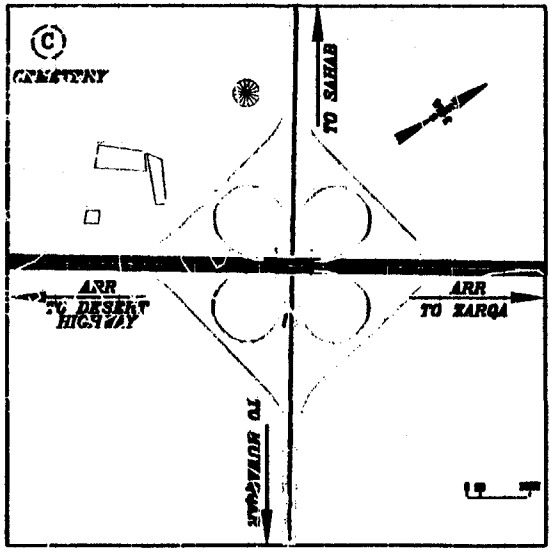
This ZEBP is meant to carry longer distance Ring Road traffic in a north-south direction thus avoiding the use of the accident prone trumpet interchange that links the Zarqa Highway with the Zarqa By-Pass. The most suitable grade separated interchange configuration to cater for north-south traffic movement is a simple two ramp directional interchange allowing north-south movements only. This is recommended at both locations. (Figure 2.6A).

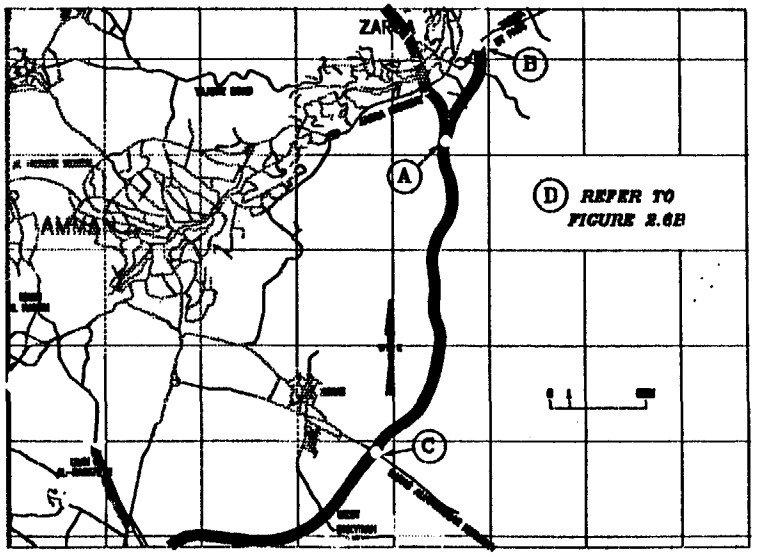
Yajouz Road

Five options for interchanges (Figure 2.6B) were initially considered. The preferred option comprises a signalised narrow diamond interchange, appropriate for this type of urban location and consistent with existing signal controlled junctions on Yajouz Road on either side. The actual location of ramp connection with Yajouz Road are however far from ideal. The crossing road gradient reaches 8% at the worst point and careful design of junction layouts will be necessary to mitigate this. Detailed design may include re-profiling of the Yajouz Road through the I/C area to lessen the effect of the gradient.





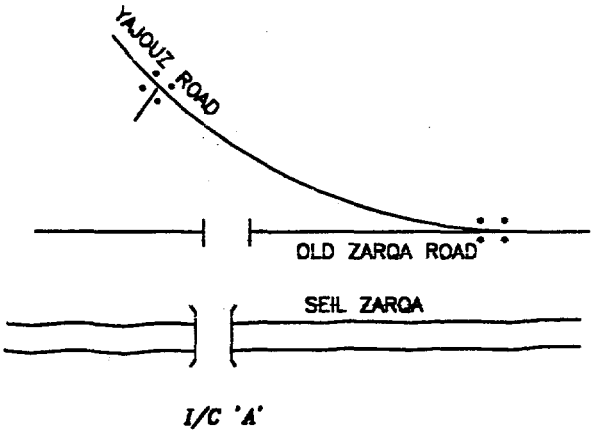




DAR AL-HANDASAH DAR AL-HANDASAH

AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 2.6A
OTHER INTERCHANGE
CONFIGURATIONS



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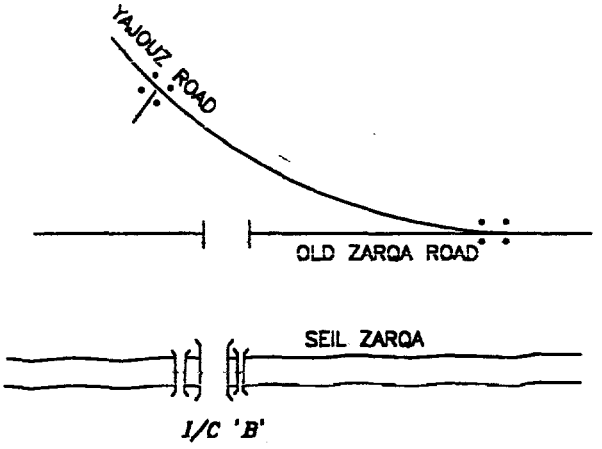

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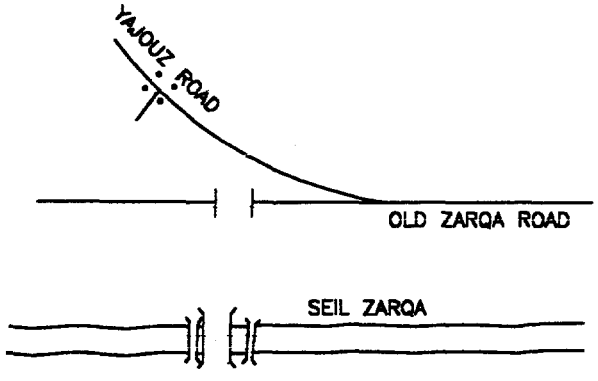

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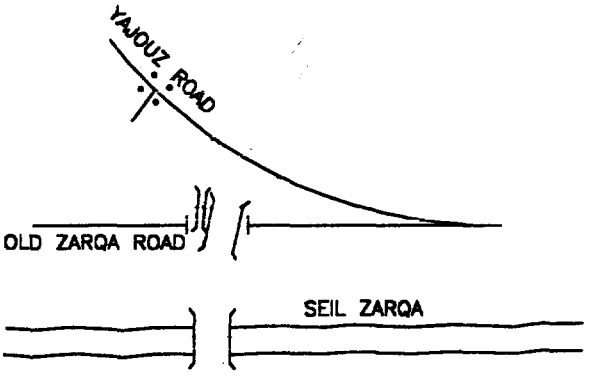
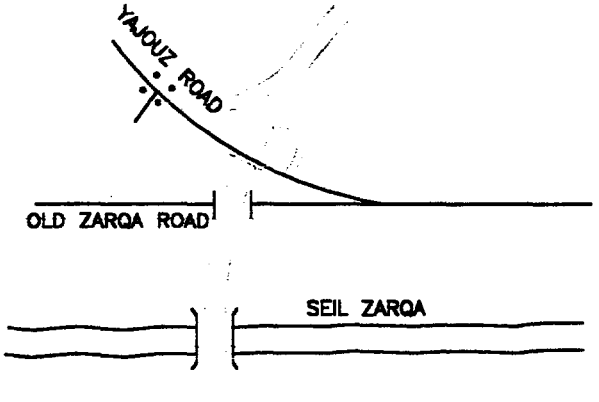


I/C 'D'
PREFERRED OPTION



I/C 'E'

DAR AL-HANDASAH — DAR AL-HANDASAH

AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 2.6B
ZARQA THROUGH ROUTE
INTERCHANGE

2.6 DESIGN STANDARDS AND GUIDELINES

The proposed ARR will be designed as a dual carriageway facility aligned through various types of terrain ranging from flat through to rolling and mountainous. The design speed of the road will be 100km/h for the majority of the route, however some sections could have reduced design speeds of 90km/h or 80km/h depending on the type of terrain.

The standard cross section comprises of a four lane divided carriageway with 3.65m wide lanes and a median width of 4.5m. A New Jersey barrier is to be provided centrally in the median to provide physical separation of opposing traffic movements.

The design parameters utilised are based on application of the latest version of AASHTO (A Policy on Geometric Design of Highways and Streets) and are summarised in Table 2.3.

Table 2.3 Current Proposals - Geometric Design Criteria (Mainline)

Parameter	Design Criteria
Design Speed, V	100 km/h level and rolling terrain 80-90 km/h mountainous terrain
Minimum Radius, R	395 m for V= 100 km/h 305 m for V= 90 km/h 230 m for V= 80 km/h
Radius with Normal Crown & no Super-elevation)	3000 m
Maximum Grade	7.0%
Minimum Grade	0.3%
Range of Vertical Curvature, K; Crest ..V=100 km/h ..V=90 km/h ..V=80 km/h Sag ..V=100 km/h ..V=90 km/h ..V=80 km/h	 62-105 m/one percent grade of A 43-71 m/one percent grade of A 32-49 m/one percent grade of A 37-51 m/one percent grade of A 30-40 m/one percent grade of A 25-32 m/one percent grade of A
Maximum Super-elevation Rate	8.0%
Maximum Relative Gradient for Profile between Edge of Pavement and PGL.	1:222 for V=100 km/h 1:210 for V=90 km/h
	1:200 for V=80 km/h
Lane Width on Main Road	3.65 m
Shoulder Width on Main Road: Right Side Left Side	 3.65m 1.25 m taken from median width
Median Width: On Bridges and Critical Cut and Fill Areas	 4.5 m including Concrete Barrier 2.0 - 4.5 m

Source: Consolidated Consultants 1997

SECTION 3:

POLICY AND LEGAL FRAMEWORK

SECTION 3: POLICY AND LEGAL FRAMEWORK

3.1 INTRODUCTION

This Section provides an outline of the existing policy and legal framework for the Project. The emphasis in this document is on the EA process. Each of the other volumes, LARP and CRIS contains a self standing description of the framework as it applies to the specific sector.

Section 3.2 provides a brief overview of the general legislative framework related to the Environment. This is followed by a more detailed review of the status of the EIA specific framework.

Section 3.3 deals with the institutional framework for the environmental sector, identifying the agencies, governmental and non governmental, that have responsibilities relating to the commissioning, supervision and management of EIAs and, or, that may contribute to the preparation and review process.

Section 3.4 outlines the approach adopted for the preparation of this preliminary EA in the context of the existing legislative and institutional framework and indicates the future stages in the project appraisal process to be undertaken.

The final Section, 3.5, provides some background in the other primary area of general Project concern, Land Use Planning and Urban Development.

3.2 LEGISLATIVE FRAMEWORK

3.2.1 General Framework

The first Draft of a "National Environment Protection Law" was prepared by the DoE in 1982. A number of subsequent drafts were then prepared in collaboration with the Higher Council of Science and Technology and other National institutions and environmental NGOs. This process culminated in September 1995 with the approval and enactment of the Environmental Protection Law, 12/95, (EPL). For reference purposes, an English translation of the EPL is included as Appendix B to this report.

The main provisions of this law are as follows:

- Establishment of a public organization called the **General Corporation for Environment Protection** (GCEP)

- Establishment of a fund called the Environmental Protection Fund, to be managed and disbursed by GCEP for environmental protection purposes. Income for the fund would come from local and foreign donations as well as from National, bilateral, and multilateral official sources.

- Establishment of a **Higher Council for Environmental Protection.**

While the EPL is now the primary source of environmental legislation in Jordan it is in effect only a framework law and GCEP is now preparing drafts of the necessary by-laws, Regulations and Directives, including that dealing with Environmental Assessment (EA),

required to make the EPL operational. At this time two Regulations, dealing with hazardous and toxic wastes have been approved, (June 1998).

Day to day environmental management and planning is thus still reliant on existing laws which were designed to regulate other sectors. It has been estimated that there are some 187 articles of legislation dealing with the environment in 19 Acts and 8 regulations. The principal pieces of legislation and their areas of jurisdiction are outlined in Table 3.1.

Table 3.1 Principal Environmental Legislation (excl. EPL)

Law	Air Quality	Water Quality	Waste Disp.	Haz. Subst.	Noise Poll.	L. Use Plan.	Nature / Forest Conserv	Arch / cult heritage
Mining Regulations (131/66)	x	x						
Public Health Act (21/71)	x	x	x					
Control of Spoiled Sites Regulations (1/78)	x	x	x	x	x			
Traffic and Transportation Act (14/84)	x				x			
Town and Country Planning Act (79/66)		x	x	x	x			
Criminal Justice Act (16/60)		x						
Agriculture Act (20/73) and (113/73)		x				x	x	
Water Authority Law (18/88)		x						
Local Authorities Act (29/55)					x			
Antiquities Protection Law (21/1988)								x

It is inevitable therefore that the existing legal framework, contains duplications, is fragmented and, in some cases, contains contradictions. Perhaps more critical is the inherent weakness in the environmental management and planning structure stemming from the overlap of responsibilities and jurisdiction between government agencies implied by the continued use of sector based regulations.

Existing specific provisions of the EPL and subordinate legislation that may relate directly to this project include:

- Controls over noise pollution: by identifying sources and setting standards for maximum allowable limits.
- Control of emission sources that may cause pollution and issuing of standards and specifications for air quality.
- Measures to protect soil from pollution and erosion
- Issuance of specifications by instruction for the protection of flora, fauna and biological life.
- Defining standards for water quality and the definition and control of sources of pollutants.
- Classifying hazardous wastes, the preparation of a National inventory of hazardous and potentially hazardous materials and their sources.

3.2.2 EA Legislation and Guidelines

The EPL addresses the issue of Environmental Assessment (EA) of projects in more than one article. For example, Articles 5, 15, 22, 26 and 34 deal with issues relating to EA (but only indirectly) and call for the drafting of the required National EA regulations and directives.

However there are some concerns that the EPL is insufficiently explicit in determining the legal basis for an EIA, and also in other areas. Two such examples are as follows:

- Article 15 states that the GCEP will work on the drafting of the required regulation for EIA. Here the original Arabic text refers to the "*Project*" in a singular form, implying each project will need its own regulation.

- Article 15 also states that the "*regulation should meet environmental and sustainable development requirements*" without defining sustainable development elsewhere.

A consensus among those consulted suggests that it is imperative, in interpreting the EPL, that it is viewed as a single entity, in which the regulations and directives of one article can not be taken in isolation from those of another.

It should also be noted that there is as yet no official or widely accepted[1] English Version of the Law in circulation.

The Draft Regulation for EIA will be issued based on Articles 15 and 34 of the EPL. At this time, the Draft Regulation itself consists of 16 Articles, that define the responsibilities for dealing with all aspects of EA process, from initial screening to final EIA statement, including the allocation of responsibility for reviewing and approving of EIAs to the concerned unit within GCEP.

Discussions with officials at GCEP, indicate that the EIA Regulation will be prepared, finalized (and potentially) approved in the first half of 1998. Moreover, it is clear from these consultations and from the regulations themselves that GCEP have no concern over the powers provided within the EPL for the enforcement of typical EIA guidelines.

At present, however, there is no effective legislation relating to the preparation of EA documentation for projects in Jordan[2]. This does not mean however, in the context of the ARR that the project will not be legally required to be subject to an EIA at a point in the future.

[1] It is the Consultants understanding that the versions in circulation at present do not provide a true translation of the law and its intent.

[2] The Aqaba Region Authority have prepared an Operational Directive (ARA EIA OD 95) as part of the Project Preparatory Advance for the Jordan Marine Pollution Action Plan that will require the preparation of EIAs for all projects that may have "significant effects on the environment, natural resources, and community by virtue of their location, resulting activities nature or size." This OD has however not yet been approved.

Similarly, as it stands at present, the EIA regulation prepared will be general in nature, and applicable to all development projects.
Specific regulations and guidelines for major for road projects are therefore unlikely to be available in the near future and, accordingly, recognised international guidelines will need to be adopted. For this project the WB guidelines will be utilised.

3.3 INSTITUTIONAL FRAMEWORK

3.3.1 GCEP

From January 1st 1996, and as a result of the reforms in the environmental sector brought about by the enaction of the EPL, the government agency with primary responsibility for environmental matters became GCEP.

Under this law, GCEP was established as an autonomous body with managerial and financial independence. It was placed within the oversight of the Council of Environmental Protection and is to report to the Minister of Municipal and Rural Affairs and the Environment.

The EPL gives GCEP, the authority to prepare the by-laws, Regulations, Directives and Guidelines as stated in the Law, and thereafter to enforce the EPL. GCEP will also, in coordination with other concerned bodies, establish a policy for environmental protection and elucidate the strategy for its implementation.

Finally, GCEP is to prepare environmental standards and specifications, including dealing with hazardous waste, and establishment of national protected areas, be responsible for monitoring of industrial, commercial, vocational or any other establishment to ensure compliance with environmental regulations; offenses would be referred to court with penalties for non-compliance.

GCEP has a number of units / departments as outlined in Figure 3.1. The function and operation of these departments is self explanatory.

Of most concern to this project (at least during the project preparation phase) will be the Environmental Impact Assessment Unit (EIAU) that has been charged with the prepared of the draft regulations for EA.

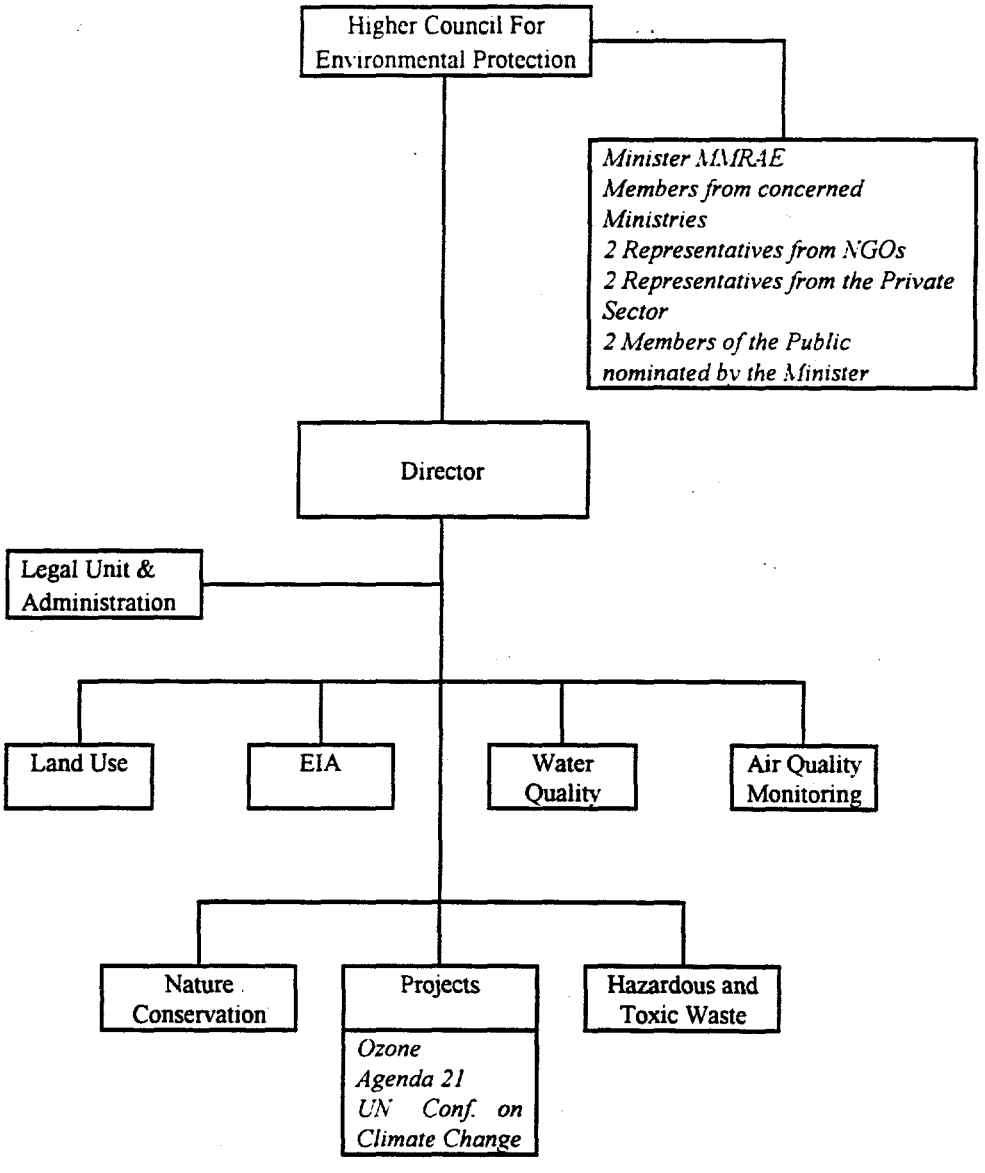
At this time, GCEP, is in the early stages of capacity building, and is being supported in this by projects sponsored by the UNDP, (Capacity 21) and GTZ, (Environmental Capacity Building for GCEP).

3.3.2 Higher Council for Environmental Protection

The Higher Council for Environmental Protection is given a mandate by the EPL to approve environmental policies and strategies, and rules and regulations as developed by GCEP and, at its own discretion, issues regulation, decisions, and propose new laws.

It is headed by the Minister of Municipal and Rural Affairs and Environment and will comprise 21 members from the public sector (mostly secretary generals of involved ministries) and the private sector.

Figure 3.1 Organogram for GCEP



3.3.3 MMRAE

In 1980, in line with increased international and local concerns over environmental issues, and in response to a perceived growing need to strengthen environmental management and planning in Jordan, the Government of Jordan established the Department of Environment, within the then Ministry of Municipal and Rural Affairs (MMRAE).

The DOE was a modest government department with limited leverage and capabilities, and without the ability to function as an independent entity. As such it had only limited influence and was never really in a position to effectively coordinate activities ongoing in the environmental sector.

Nevertheless, DoE played an important role, in filling the gap left by the absence of an independent governmental body dealing with the environment. Furthermore, in following up international conventions and treaties, undertaking public awareness and education campaigns, monitoring of air and water quality and inspecting solid waste dumping sites, DoE contributed significantly to raising National levels of awareness over the environment.

The DOE remains operational today and with its cadre of well trained staff has the potential to make a significant further contribution to sector development and management.

3.3.4 MPWH

The sponsoring Ministry, MPWH have at this time no effective environmental management or planning capacity.

3.3.5 Other Central Agencies

In addition to GCEP and DOE, other sectoral ministries have taken on responsibilities for environmental regulation and the management of environmental affairs. According to the National Environmental Action Plan, (NEAP) there are a total of 18 government agencies in 10 different ministries currently active in the environmental field, (Table 3.2).

Several of these Ministries have created environmental units within their own structures to address environmental issues which arise within the Ministry. Major contributors in this context would include the Ministries of Health, Water and Irrigation, Interior, and Agriculture.

Finally, in addition to the sectoral ministries, there are a further two national entities with specific responsibility for environmental planning and policy formulation.

- the Ministry of Planning is responsible for preparing the National Economic and Social Development Plan which includes an environmental component and it co-ordinates, prioritises and seeks donor support for environmental projects and programmes within the Plan framework. The Ministry co-sponsored, with MMRAE, the development of the NEAP.
- the Higher Council for Science and Technology, which is mandated to set public policies and strategies for science and technology in a number of sectors, including the environment.

Table 3.2 National Institutional Responsibilities for Environmental Management

INSTITUTION	AREA OF RESPONSIBILITY						
	Cross-sectoral			Water Resources	Land Resources	Urban Environmental	Cult. & Nat. Heritage
	Planning and Policy	Standards	Monitoring				
MA					■		
MA/DAF							■
MA/DPP		■					
MA/PRL			■				
MEMR/DOP	■					■	
MEMR/JEA						■	
MEMR/NED			■			■	
MEMR/NRA					■		
MEMR/RED	■					■	
MH/EHD			■	■		■	
MH/HSD			■			■	
MI/CDD/DD						■	
MIT/DSM		■		■		■	
ML/OSHI			■			■	
MMRAE/DOE	■	■				■	■
MP/EU	■						■
MPWH/HUDC						■	
MTA/DOA							■
MTA/DOT							■
MWI/WAJ	■	■	■	■		■	
HCST	■				■		
RSS/ERC			■	■		■	
RSS/RERC						■	
RSCN					■		■

MA	Ministry of Agriculture
MA/DAF	Ministry of Agriculture/Department of Afforestation and Forests
MA/DPP	Ministry of Agriculture/Department of Plant Protection
MA/PRL	Ministry of Agriculture/Pesticide Residue Laboratory
MEMR/DOP	Ministry of Energy and Mineral Resources/Dir. Of Planning
MEMR/JEA	Ministry of Energy and Mineral Resources/Jordan Electricity Authority
MEMR/NED	Ministry of Energy and Mineral Resources/Nuclear Energy Department
MEMR/NRA	Ministry of Energy and Mineral Resources/Natural Resource Authority
MEMR/RED	Ministry of Energy and Mineral Resources/Renewable Energy Directorate
MH/EHD	Ministry of Health/Environmental Health Division
MH/HSD	Ministry of Health/Health and Safety Division
MI/CDD/DD	Ministry of Interior/Civil Defense Directorate/Disaster Department
MIT/DSM	Ministry of Industry and Trade/Dir. of Standards and Measures
ML/OSHI	Ministry of Labor/Occupational Health and Safety Institute
MMRAE/DOE	Ministry of Municipal and Rural Affairs and the Environmental/Department of Environmental
MP/EU	Ministry of Planning/Environmental Unit
MPWH/HUDC	Ministry of Public Works and Housing/Housing and Urban Development Corporation
MTA/DOA	Ministry of Tourism and Antiquities/Department of Antiquities
MTA/DOT	Ministry of Tourism and Antiquities/Department of Tourism
MWI/WAJ	Ministry of Water and Irrigation/Water Authority of Jordan
HCST	Higher Council for Science and Technology
RSS/ERC	Royal Scientific Society/Environmental Research Center
RSS/RERC	Royal Scientific Society/Renewable Energy Research Center
RSCN	Royal Society for the Conversation of Nature

3.3.6 Regional and Municipal Institutions

No less important in environmental management are the regional and local authorities, which include the semi-autonomous bodes such as the Water Authority, the Jordan Electricity Authority, the Jordan Valley Authority, the Aqaba Regional Authority, and the Aqaba Port Corporation, and the Municipalities.

For example, the Aqaba Regional Authority is taking the lead responsibility for implementation of the Gulf of Aqaba Environmental Action Plan and in that capacity plays a major role in managing the Aqaba Region. Its institutional responsibilities include coordination of efforts with other relevant institutions and the management of investments and technical assistance

The Municipalities could also play a significant role in urban environmental management. However, with the exception of the Municipality of Greater Amman, financial limitations prevent these municipalities from undertaking effective environmental action.

However, despite the wide range of actions undertaken at national, regional, and local levels for the benefit of Jordan's environment, there is little coordination at the national level and no clear national strategy or overall action plan. As a result there is duplication of effort, while elsewhere key actions may be left undone, and no clear priorities are not established.

3.3.7 Research Institutions

This governmental structure is supported by a number of research organisations with a strong environmental emphasis. These include:

- **Royal Scientific Society (RSS)**

The RSS is a research institute of international repute that provides a substantial body of research in a wide range of fields annually. Environmental activities within the RSS are undertaken principally by the Environmental Research Centre (ERC) which provides scientific and technical advisory services to the public and private sectors. Primary areas of research for the ERA, at the present time, are the monitoring of water quality and air quality.

- **Royal Jordanian Geographic Centre (RJGC)**

The RJGC provide mapping and GIS services to the public and private sector and thereby provide the basic spatial referencing system for all environment related activities and research. Of equal importance is the potential role of the Remote Sensing Section in environmental monitoring.

- **University of Jordan**

There are three units at the University of Jordan that are particularly active in environmental fields of study;

Dept. of Biological Sciences: Studies and research on the biogenetic diversity and genetic resources of Jordan.

Centre for Water and Environmental Research and Studies: Focuses on water related issues in the agricultural sector.

Technical Consultations and Studies Centre: Provides training in a wide of environmental fields and in resource management.

- **Yarmouk University**

The Department of Earth Sciences and the Environment provides formal education at the undergraduate and post graduate level in geology and related areas of expertise of relevance to environmental studies. The university also jointly administers the Aqaba Marine Science Station with the University of Jordan.

3.3.8 Non Governmental Organisations

Only two agencies are highlighted in the text below but in the context of this project the potential for significant contributions from a large NGOs and CBOs can not be overestimated.

- **Royal Society for the Conservation of Nature (RSCN)**

The RSCN has played a. pre-eminent role in environmental management in Jordan since its establishment in 1966. It has particular concerns with the establishment and management of Wildlife Reserves, using authority delegated from the Ministry of Agriculture (MOA) to supervise reserves and enforce hunting regulations. It is also active in raising environmental awareness and has an international standing reinforced by its strong links to agencies such as the International Union for the Conservation of Nature (IUCN).

- **Jordan Environmental Society (JES)**

JES was established in 1988 to address environmental concerns within the context of, and in accordance with, national priorities and to raise the level of environmental awareness among all strata of Jordanian society.

Today, it comprises over 4000 members including more than 100 companies. It has a broad range of goals, well defined in their 1996 Annual Report:

- To work towards the adoption of policies and application of necessary standards and procedures to protect the Jordanian Environment and control pollution within the framework of the National Environmental Strategy.

- To attract concerned people and specialists in the fields of environmental protection and provide appropriate conditions which are conducive to initiatives and participation in the effort to reach a clean environment.

- To identify local environmental problems and participate in developing solutions to such problems according to priorities and to control all forms and sources of pollution whether, industrial, chemical or biological.

- To promote environmental awareness of all sectors of society and help create individual and National commitment in dealing with issues of the environment and rationalising the use of its elements.

In keeping with these goals, the JES has established 21 branch offices throughout the country. Of these, six, at Amman, Fuheis, Zarqa Salt, Sahab and Madaba are in areas that may be directly affected by the project. Ongoing projects/activities of these offices that are of direct relevance to this project are outlined in Table 3.3.

Table 3.3 Activities of Local Branches of JES

Branch	Projects
All/Amman	The National Environmental Information and Education Programme National Clean Up Campaign Awareness Project in Water
Fuheis	Pollution caused by the cement industry Successful campaign against pollution caused by Sand Extraction and Mining
Zarqa	Black Agricultural Plastic and its effect on animals
Salt	Development of an Environmental map for the Governorate
Sahab	Participation in the Industrial Estates Corporation Meetings
Madaba	Study of the Madaba Treatment Plant

Source: JES Annual Report 1996

One of the major functions of JES therefore is as a pressure group for environmental protection.

Other principal environmental NGOs include, the Jordan Society for Desertification Control and Badia Development and the Friends of the Environment Society.

In the specific field of Archaeology there are a number of prominent NGOs including; American Centre for Oriental Research (ACOR), the Friends of Archaeology (FOA) and British Institute at Amman for Archaeology and History, (BIAAH), Institute Francais d'Archelogie du Poche Orient (IFAPO).

The work of these agencies is supported by other NGOs and many large social NGOs, particularly Queen Alia Fund and Nour El Hussein Foundation that have related activities such as the Consumers Protection Society.

CBOs are also commonly found throughout the country operating in a number of fields primarily related to social welfare and community support.

3.3.9 Summary

With the relatively recent enactment of the EPL and with the process of making the act operational as yet incomplete, the environmental sector in Jordan remains in a state of transition. It is inevitable in such circumstances that environmental responsibilities will continue to reside with a range of Government agencies that, in some cases, do not enter in to (and have not in the past) the coordination at the national level necessary to permit environmental efforts to be most effectively focussed. This is to a large extent unavoidable as agencies establish themselves in the new order of reality.

Moreover it is unlikely that the situation will change significantly during the remaining elements of project preparation for this Phase of the Project.

Conversely, this dispersal of responsibility, has during the thirteen year period required to develop and approve the Environment Protection Law, proved something of bonus as parallel efforts during this time were undertaken by governmental bodies, supported by local and international non-governmental organizations and international agencies to prepare all parties concerned to deal with the environmental law.

This has created a large cadre of professionals scattered throughout the public and private sector that have been trained in the development of EA guidelines and in the use of EA techniques and programmes.

3.4. PROJECT ENVIRONMENTAL APPRAISAL FRAMEWORK

3.4.1 National Context

In the absence of legally enforceable National guidelines the principal sources of country specific guidance and context were the National Environmental Strategy and the National Environmental Action Plan.

National Environmental Strategy

In 1991, the DoE, in cooperation with the IUCN and USAID, engaged 180 Jordanian specialists in the preparation of the National Environment Strategy (NES). This recommended five strategic directions for action:

- Constructing a legal framework for environmental management, including the enactment of a comprehensive environment law and complementary environmental legislation, and the creation of a national environmental impact assessment process.
- Institutional Strengthening
- An expanded role for Jordan's Protected areas
- Bringing the environment to the People
- Stemming population growth.

Sectoral priorities were allocated to the issues of water and maintaining agriculturally productive land.

National Environmental Action Plan

The principal recommendations in the NEAP relating to the ARR are those concerning Land Resource Management as a list of priority actions in Table 3.5. Many of these

recommendations parallel those of the Agricultural Policy Charter[3] (APC). Among the key recommendations relevant to the ARR are:

- provision of a legal basis for development and enforcement of a national land use plan to achieve optimum use of land among competing user groups: agriculture, grazing, mining, urban development, tourism, and transportation.
- addressing land tenure problems particularly in the Badia to halt or reverse desertification.
- the declaration of all Government forest lands national reserves to help ensure their preservation.
- controlling urban expansion.

More details of these proposals are provided in Appendix C.

Table 3.5 NEAP: Phase 1 Environmental Priority Actions Relevant to ARR

NEAP Priority Action	Project Ref No. (See Appendix C)
Land Resources	
Promotion of public awareness and participation	12
Development of a national land use planning and zoning system	13
Preservation of forest lands	16
Environmental impact assessment of all infrastructure projects	17
Rehabilitation of mining sites and quarries	19
Rangeland development	20
Urban Environment	
Development of regulations to control urban and industrial pollution	21
Treatment, storage, and disposal of hazardous waste	22
Establishment of environmental monitoring system	23
Closure and Replacement of Waste Disposal Sites at Marka and Akaider.	25
Survey of environmental parameters of main cities	26
Urban and regional land use planning	27
Cultural and natural heritage	
Community involvement in development/management of protected areas	28
Improved management of national cultural and natural heritage	29
Development of by-laws for natural and cultural heritage preservation	30
Development of a data base for traditional sites	34

Source: NEAP

[3] The recently completed APC is seen an important planning document in support of the NEAP process and it is recommended in the NEAP that the Government adopt and apply the APC, following a review by GCEP.

Table 3.4 National Environmental Actions Required in Land Resources Management

Priority Issue	Legislation, Regulation	Investments	Economic Instruments	Institutional Instruments	Information Instruments	Public Awareness Instruments
Land Degradation						
Absence of land use plans	Set up national land use planning system			Identify and equip. appropriate Gov. agency		
Soil erosion and siltation of reservoirs and floodplains	Revise & enforce laws, make land tenure laws and regulations compatible	Implement watershed management, afforestation, land resource management	Increase fines for cutting trees	Strengthen police authority of MA/DAF, & MI CDD DD for flood control	Use indigenous us tree species	Involve local communities in forest protection. Use media to educate public
Deforestation	Prohibit use of forest land for other purposes. Declare all Gov. forest national reserve	Equip. Civil Defense for Forest Fire fighting. Promote MA annual afforestation program	Tax urban land. Tax land value added through speculation	Manage and control range use. Include environmental expert on Municipal Development Council		Involve local communities
Range land deterioration	Arrange land tenure in the Badia	Create alternative employment in the Badia.			Study range reserves	Involve Bedouin target group in range development
Urban encroachment	Introduce urban/regional land use planning/zoning			Conduct EIAs for urban development		
Mining spoils	Enfore mine closure act	Rehabilitate mines		Conduct EIAs for mine development	Sector EIA of mining industry	
Land Contamination						
Solid & liquid waste disposal	Revise & enforce laws	Upgrade waste treatment, and technology for mine pollution				
Soil salinsiation				Improve water management in irrigation		

3.4.2 Project Environmental Appraisal Programme

The Project Environmental Appraisal programme includes two principal components:

(i) Environmental Assessment

Subsequent to this Environmental Assessment, the alignment will be developed to a detailed design stage and environmental covenants integrated into the Tender documentation. Design reviews will also be undertaken.

(ii) Information Participation and Consultation Programme

The IPC Programme was designed to have three components.

- Scoping Sessions
- Thematic Seminars
- Public Exhibitions

For each element of the programme five tasks have been undertaken:

(i) Visits to concerned parties to introduce the ARR project.
(ii) Collection of information and site visits.
(iii) Preparation of preliminary information materials.
(iv) Implementation of structured meetings for target groups comprising:
(v) Reporting

All elements of this program have now been completed and are reported on in Volumes 3 and Volume 4 of the Pre Feasibility Report (the Scoping Report and the Moderators Report on the Scoping Sessions respectively) and in Volume 5 of this submission.

3.5 PROJECT PLANNING FRAMEWORK

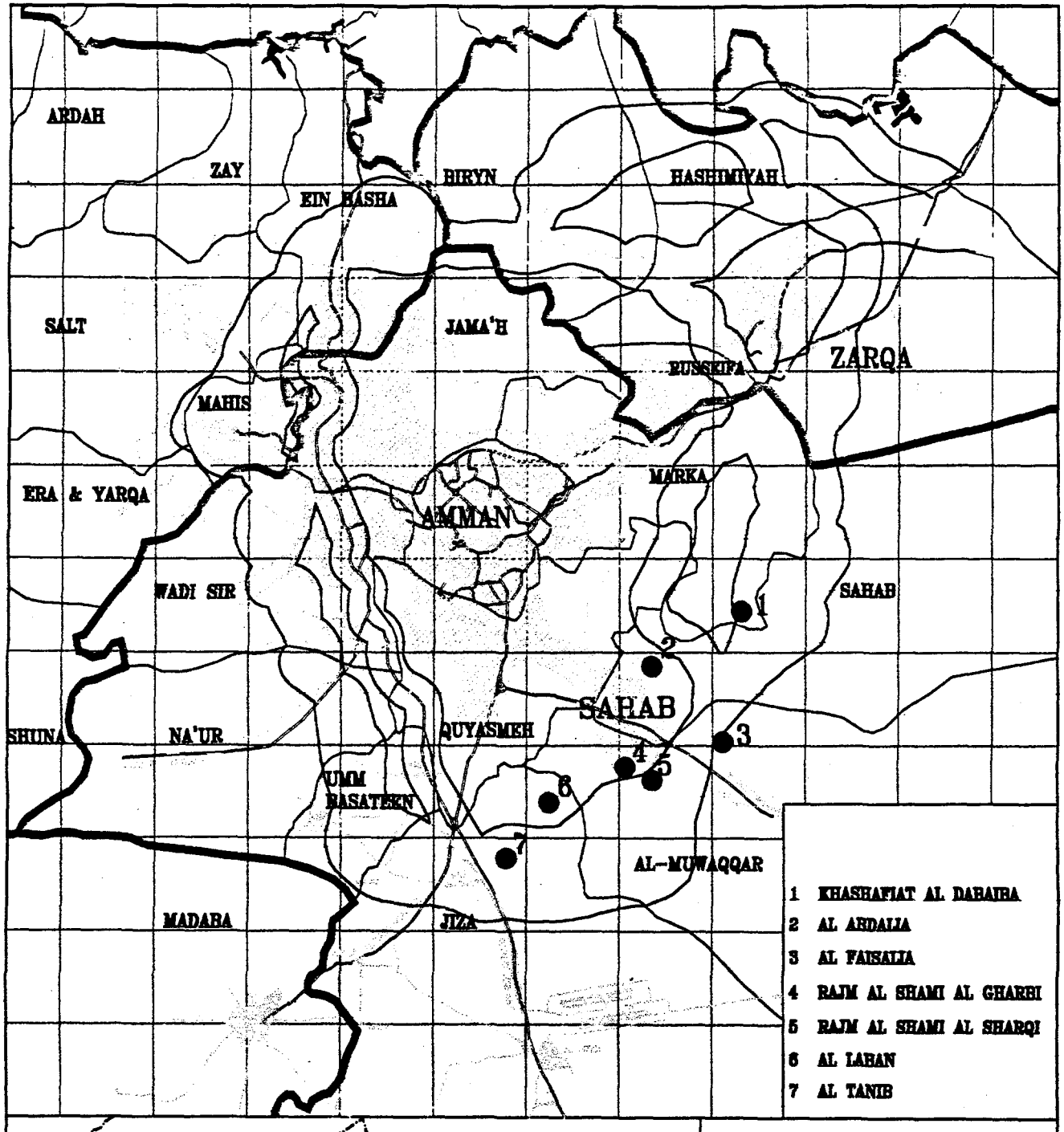
This Section provides a brief overview of the planning process relevant to the Project. A more detailed assessment is provided in Appendix D.

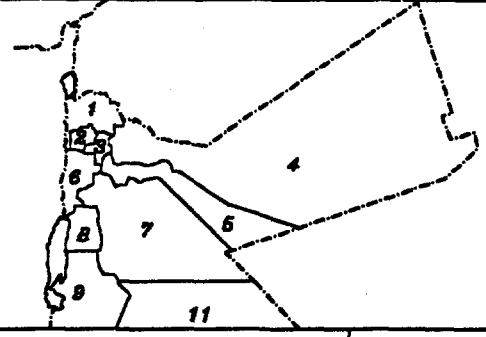
3.5.1 Implementation Framework

Local administration in Jordan is split as follows:

- Governorates, under the Ministry of the Interior, (with sub-Governorates, districts and sub-districts) that are concerned with security matters, provision of services outside municipal areas, and some regional planning functions.
- Municipalities, reporting to the Ministry of Municipalities and Rural Affairs and the Environment. MMRAE is also responsible for regional planning. The Amman Municipality is in a separate category, as the Mayor carries Ministerial rank.

There are in addition approximately forty government corporations or authorities providing services or coordinating functions. An outline of the administrative boundaries affecting the project is provided in Figure 3.2.





GOVERNORATES

1 *IRBID*
2 *AJLUN*
3 *JERASH*
4 *MAFRAQ*
5 *ZARQA*
6 *BALQA*
7 *AMMAN (CAPITAL)*
8 *MADABA*
9 *KARAK*
10 *TAFILAH*
11 *MA'AN*

LEGEND

ALIGNMENT CORRIDOR
GOVERNORATE BOUNDARY
DISTRICT BOUNDARY
AFFECTED COMMUNITY

AMMAN RING ROAD
Technical And Economic Evaluation

FIGURE 3.2
ADMINISTRATIVE BOUNDARIES

Within the framework of Law 29 of 1955 (amended), Municipalities were allocated a wide range of functions and Central Government now expects local governments to play an expanded role in supplying services to local populations and in stimulating local growth, especially in the smaller centres. Simultaneously, however, many major municipal functions have been or are being ceded to central ministries .or. special agencies (e.g. water and sewerage, electricity, education, health, and emergency services).

The most significant public services involving major budgetary expenditures that continue to be provided by all municipalities are construction and maintenance of local roads and refuse collection and disposal. Beyond that municipality functions are largely regulatory; licensing activities, including, most importantly in the development context, planning and building controls.

The MMRAE is responsible for the administration of local government outside Amman, and controls the implementation of planning legislation regulations and standards throughout the country. Through the Department of Regional Planning the Ministry controls the preparation of regional plans and authorities and controls all development outside planning areas and in those regional planning areas which do not have approved land use plans.

3.5.2 The Planning Process

Law 79 of 1966 sets out a logical and comprehensive system for planning regions, cities and villages, very much on the model of British town planning legislation of the period. The Law defines three levels of planning authority as indicated in Table 3.6:

Table 3.6 The Planning Process

The Supreme Planning Council	SPC is the authority responsible for approving all regional plans and local master plans. For the capital region, the Prime Minister replaces the Minister of MMRAE as Chairman. The SPCs tasks include: (i) the creation, extension and modification of planning areas (ii) final approval of regional and master plans (iii) approval of regulations, systems or standards proposed by the Planning Department (iv) determination of conflicts between local and regional councils (vi) setting the guidelines for national planning policy.
Regional Planning Committees	RPCs, approve all detailed plans and regulations for specific projects, and make recommendation to the SPC on regional, master, and detailed plans. A Regional Council will: (i) consider objections to regional or master plans and make recommendations on them to SPC. (ii) approve detailed land use plans, and consider objections to decisions of local councils (iii) exercise planning authority over the regional planning area.
Local Planning Committees	LPCs have responsibility to prepare plans for designated planning areas (municipality, commune or part of a commune). LP Councils are responsible for: (i) preparing or initiating master or detailed plans in cooperation with the central Planning Department. (ii) approving land subdivision, licences buildings, and controlling all aspects of development, planning, building, public health and public safety. (iii) collecting those taxes and fees due.

Table 3.6 The Planning Process

Specific Agencies:. Common Multi-Regional and/or Local Committees. **e.g. MRP**	Are set up for specific regions or areas for regional and/or local planning purposes. Tasks are defined on their creation but usually are: (i) a combination of the tasks of local planning and/or regional planning councils; (ii) delegated tasks from the SPC.

In this study region the MRP are responsible for the planning of the Middle Region Area to year 2020. Its role is primarily consultative, and no authority has yet been given to it.

3.5.3 Planning Problems

There are a number of obvious disparities between the requirements of the current planning legislation on the one hand, and of the practice and administration of development and land use planning and of planning control in the study area on the other.

These are reflected in three potentially significant areas of concern.

- in the absence of approved plans
- in the relationship between approved plans, subdivision permits, building permits and occupancy permits, and in particular unlicensed development and the post facto licensing of unauthorised development.
- the extent to which the objectives of land use planning are being thwarted by the development process and by development as it proceeds, unplanned.

A more detailed review of the planning process and associated concerns is provided in Appendix D.

SECTION 4:

BIOPHYSICAL ENVIRONMENT

SECTION 4: BIOPHYSICAL ENVIRONMENT

4.1 INTRODUCTION

This section outlines the status of the biophysical environment in the Study Area and its immediate surrounds. The following Section 6, provides an overview of socio-context for the project and taken together the two, Sections may be read as providing the assessment of the Baseline Conditions for the project.

Section 4.2 provides a summary of climate data of relevance to the project and Section 4.3 a brief outline of sub regional geological conditions including seismology. This is followed by a Section detailing the landform soils and topography of the area in question. In this context the analysis is predominantly oriented towards assessment of land capability rather than geotechnical considerations.

Section 4.5 contains a summary of the present status and condition of the natural vegetation and a profile of the distribution of the larger elements of the fauna, Birds, Mammals and Reptiles.

Sections 4.6 and 4.7 deal with the hydrological resources of the area. In Section 4.6 the principal features of the surface hydrology are identified together with a summary of available data on water quality, both chemical and microbiological. The principal groundwater resources of the region and associated aquifer recharge zones are identified in Section 4.7, together with a summary of known trends in groundwater quality and patterns of use.

Air quality considerations are reviewed in Section 4.8 and Noise in Section 4.9.

The penultimate Section contains summary information on the known Historical and Cultural Sites of the Corridors. The sites defined were identified by the DAJ from JADIS and from walkover surveys of defined alignments. A more detailed review of the sites identified in this document is provided in Cultural Resources Impact Assessment Report (CRIA), Volume 4 of this submission.

The final Section, 4.11, contains an initial statement of the quality of the data base reviewed, highlighting particular areas of concern and where appropriate, identifying works that could be undertaken to supplement known data.

4.2 CLIMATE

The study area lies within two climatic zones, the Steppe and Cool Desert Zones defined by Koppen and shown in Figure 4.1.

The Steppe Zone is defined as having rainfall of less than 300mm. Average annual temperatures do not exceed 18°C. Temperatures are high in the summer, (over 42 °C) but mild in the winter. Annual Evapotranspiration rates exceed 1450mm.

The easternmost Sections of the Project area lie within the Cool Desert Zone. This area is markedly drier with a moisture regime that is essentially aridic, with unreliable annual rainfall of rarely more than 200mm.

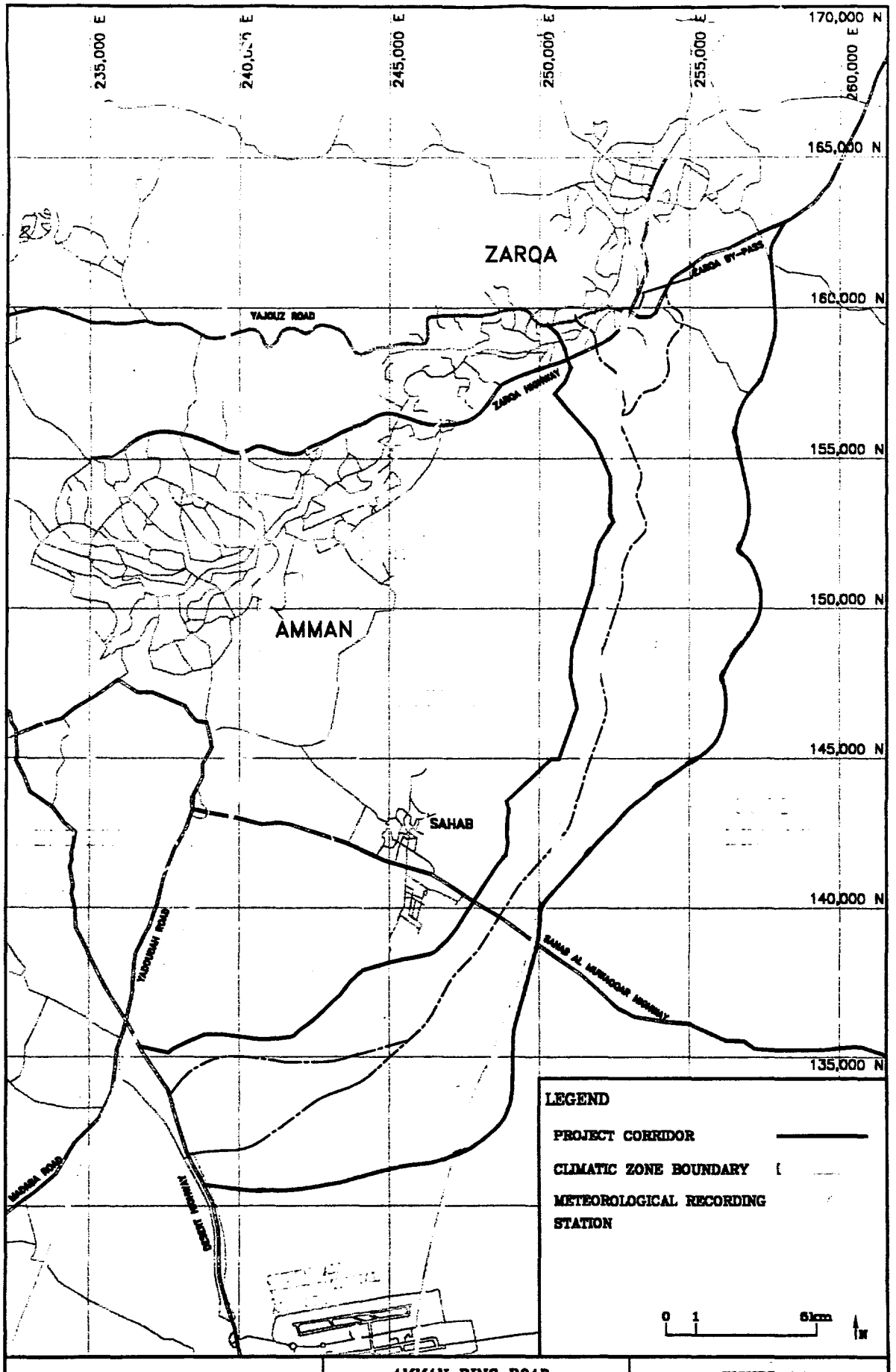


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FIGURE 4.1
CLIMATIC ZONE

Summaries of the climatological data for the two principal stations located within these zones are shown in Figure 4.2 and in Table 4.1.

Table 4.1 Summary Climatic Data

Climatic Parameter	Amman Airport	QAIA
Absolute Ann Max Temp °C	42.8	42.5
Absolute Ann Min Temp °C	-7.5	-7.4
Mean Monthly Max Temp °C	32.4	31.7
Mean Annual Temp °C	17.3	15.5
Mean annual rainfall (mm)	275	177
Mean annual number raindays (>0.1mm)	52.7	32.9
Mean Annual Potential Evapotranspiration (mm)	n/a	1477

Source: Climatological Data Handbook. 1988

In a project specific context, while the climate of the study area is not unduly extreme there are a number of climatological factors of significance to road design and operational safety. These are reported in Table 4.2.

Rainfall intensities (as recorded at Amman Airport) are relatively light:

Time (mins)	5	10	20	30	60
Amount (mm)	7.9	9.2	15.2	19.5	21.2

The maximum recorded rainfall in a 24 hour period is as follows.

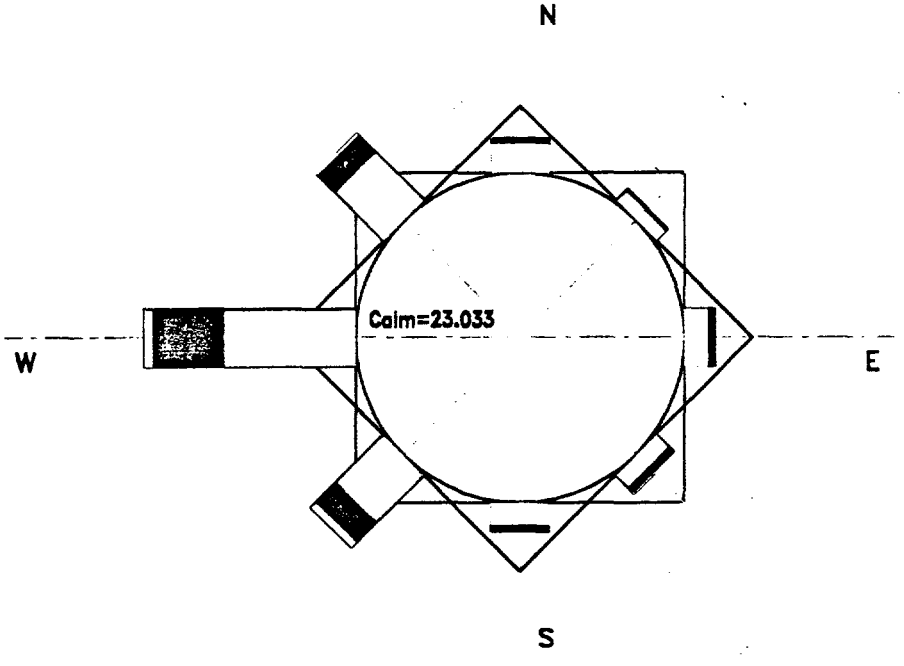
10 Year Storm	63.1mm
50 Year Storm	84.9 mm
100 Year Storm	94.0 mm

Prevailing winds are from the south west virtually throughout the year throughout the region. Speeds are generally light either calm or < 20 knots for >90% of the time at the Amman and QAIA airport. Gales are however common on an annual basis and maximum recorded monthly wind gusts are significant, especially in the winter months at 50 to 70 knots. These are often associated with blowing sand that may be sufficient to cause the closure of QAIA and over a longer period generate significant nuisance.

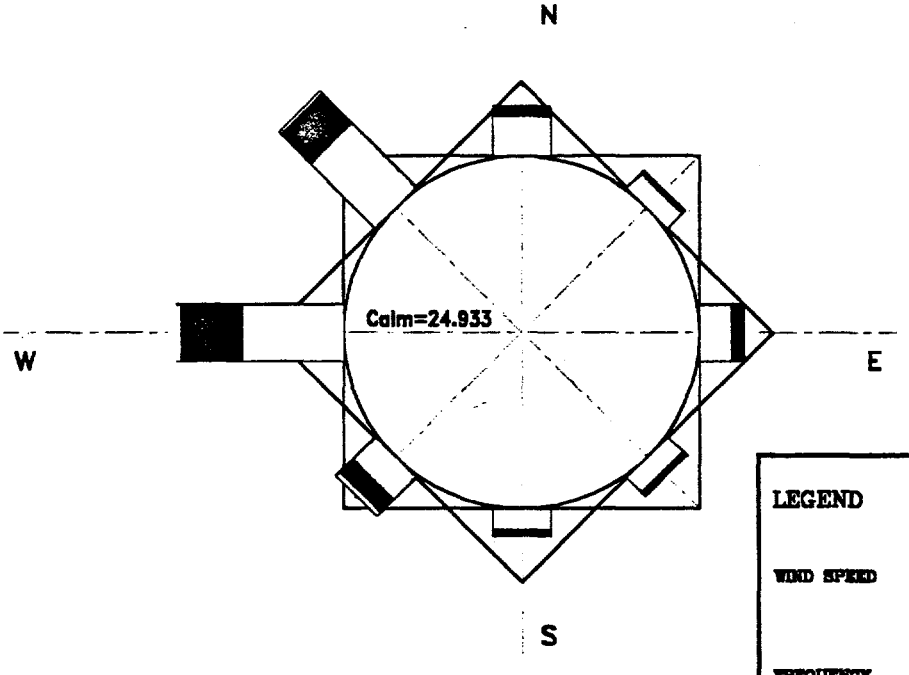
Snowfalls occur, though as with rainfall they decline markedly with altitude and longitude. Within the ARR region the University of Jordan to the NW experiences an average of 3.4 snow days per annum but QAIA less than one. Falls tend to be associated with passing Polar fronts and rarely linger beyond 2-3 days, however they are usually sufficient to cause serious disruption to traffic and are frequently associated with a spate of accidents.

Fog incidences are also not uncommon, particularly in the early morning and late evening. The long term data available is unfortunately very coarse, recording only visibility below 1000m but it does confirm the frequent occurrence of 'low visibility' events.

Similarly such data does not reflect the nature of the events themselves. Anecdotal evidence indicates that dense fogs are frequently short lived phenomena, occurring and dispersing extremely rapidly. They are also apt to be highly localised, being particularly prevalent in depressions, a combination that is particularly dangerous to drivers on high speed roads.



STATION : AMMAN AIRPORT



STATION : Q.A.I.AIRPORT

LEGEND

WIND SPEED 1-10 11-21 22-33 >34 (knots).

FREQUENCY 0% 10% 20% 30%

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Table 4.2 Significant Climatological Events

Station	Elev. (m)	Latitude (N)	Longitude (E)	Records
Amman Airport	766	31 59	35 59	1923 - 87
Queen Alia International Airport (QAIA)	715	31 43	35 59	1971 - 87
Zarqa Refinery	555	32 05	36 07	1966 -87

A. Maximum Monthly and Yearly Wind Gust: (knots)

Station	J	F	M	A	M	J	J	A	S	O	N	D	Yr.
Amman Airport	72	63	62	61	60	58	51	46	46	56	59	67	72
QAIA	51	50	52	59	68	51	40	35	35	57	51	51	68

B. Mean Monthly and Yearly Number of Days with Gale: (> 34 knots)

Station	J	F	M	A	M	J	J	A	S	O	N	D	Yr.
Amman Airport	1.4	1.5	1.1	0.4	0.3	0.1	0.1	0.1	0.1	0.1	0.4	0.4	5.8
QAIA	0.4	0.1	0.1	0.1	0.1	0.1	0	0	0	0	0.1	0.3	1.3
Zarqa Refinery	0.1	0	0	0.1	0	0	0	0	0	0	0	0	0.2

C. Prevailing Wind Direction (Degrees)

	Nov. - Feb.	Mar. - June.	July - Oct.	Annual
Amman Airport	220 - 242	255 - 283	271 - 289	268
QAIA	204 - 253	275 - 289	286 - 300	288

D. Mean Monthly and Yearly Number of Days with Thunderstorm

Station	J	F	M	A	M	J	J	A	S	O	N	D	Yr.
Amman Airport	0.6	0.5	0.7	0.8	0.8	0	0	0	0.2	0.9	1.2	0.6	6.3
QAIA	0.2	0.1	0.3	0.3	0.2	0	0	0	0.1	0.2	0.1	0.1	1.6

E. Mean Monthly Number Days with Dust: Visibility < 1000m

Station	J	F	M	A	M	J	J	A	S	O	N	D	Yr.
Amman Airport	0.1	0.2	0.3	0.2	0.1	0.1	0	0	0	0	0.1	0.2	0
QAIA	0	0	0.2	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	1.6

F. Mean Monthly Number of Fog Days: Visibility < 1000m

Station	J	F	M	A	M	J	J	A	S	O	N	D	Yr.
Amman Airport	1.4	0.7	0.4	0.2	0	0	0	0	0	0.1	0.3	0.8	3.9
QAIA	1.8	1.2	1.3	0.5	0.1	0	0	0.1	0.1	0.4	1.9	2.3	9.7

G. Mean Monthly and Yearly Number of Days with Snow

Station	J	F	M	A	M	J	J	A	S	O	N	D	Yr.
Amman Airport	0.7	1.1	0.3	0	0	0	0	0	0	0	59	0.2	2.3
QAIA	0.3	0.3	0.2	0	0	0	0	0	0	0	0	0	0.8
Zarqa Refinery	0.3	0	0.1	0	0	0	0	0	0	0	0	0.1	0.5

H. Mean Monthly and Yearly Number of Days with Hail

Station	J	F	M	A	M	J	J	A	S	O	N	D	Yr.
Amman Airport	0.4	0.9	0.4	0.3	0.1	0	0	0	0	0.1	0.1	0.2	2.4
QAIA	0	0.1	0.1	0	0	0	0	0	0	0	0	0	0.2

I. Mean Monthly and Yearly Number of Days with Ground Frost

Station	J	F	M	A	M	J	J	A	S	O	N	D	Yr.
Amman Airport	14.8	11.0	7.7	1.9	0.4	0	0	0	0	0.1	2.26	10.5	47.2
QAIA	19.7	12.9	9.4	3.5	0.9	0	0	0	0	0.3	6.0	16.5	69.2
Zarqa Refinery	14.4	9.1	4.7	0.5	0	0	0	0	0	0	2.3	10.0	41.0

Source: Climatological Data Handbook, 1988

4.3 GEOLOGY AND SEISMOLOGY

4.3.1 Stratigraphy and Lithology

The geology of the study area is dominated by East Jordan Limestone Plateau, a series of Cretaceous and Tertiary calcareous sediments. A basic stratigraphy and lithology of the region is provided in Table 4.3 and shown in Figure 4.3.

Table 4.3 Basic Stratigraphy of the Study Area

Group	Age	Formation	Lithology
Belqa'a Group	Tertiary	Um Rijam Chert - Limestone	Limestones with chert layers and subsidiary areas of marls, chalky limestone and fibrous gypsum.
	Upper Cretaceous	Muwaqqar Chalk - Marl	Chalky marls, locally crystalline limestone and also locally gypsum.
		Al Hisa Phosphorite	Phosphatic limestone, marl, coquinal limestone with decreasing incidence of bedded cherts.
		Amman Silicified Chert	Very variable in nature with a high chert content in well defined bands. Grey limestone, chalk and coquinal grainstones also occur.
		Wadi Umm Ghudran	Largely chalks with some phosphatic and dolomitic limestone. Chert may also be present in the middle of the formation.
Ajlun Group	Upper Cretaceous	Wadi es Sir	Fossiliferous limestone in its upper part underlain by dolomitic limestone.
		Shueib	Thinly interbedded chalk s and brown dolomites
		Hummar	Massive marly limestone and micritic limestone overlain by dolomitic limestones
		Fuheis	Chalky limestones, marls and cherts.
		Naur	Marine limestone, dolomite and bedded nodular chert.

Source: Bender, 1988, NRA

The lithology and surface conditions of the differing sections of the alignment are described briefly below.

Section 1 (Mid Route and Red Route)

No geologic formations are exposed in this section. The surface soils are clayey sandy silts up to 5m deep in which there is a gradual increase in marl content with depth, as the soil profile merges into the underlying marly limestone bedrock. The sand silt and clay components of the residual soils varies depending to some extent upon the original composition of the bedrock.

Section 2 (South)

At the start of this section the Belqa group outcrops, forming the low hills that are typical of the area. As the corridor progresses northward, the chalky marl of the Lower Belqa (B1) is seen, rapidly transgressing to the Upper Belqa (B2 formation) composed of thinly bedded silicified limestone and black chert.

This unit continues northward, forming rocky outcrops, giving a more rugged topography. West of Wadi Al Ush, the upper part of this formation is quarried. In the northernmost areas the same formations continue with the Upper Ajlun (A7), alternating limestone and marly and chalky limestone becoming evident.

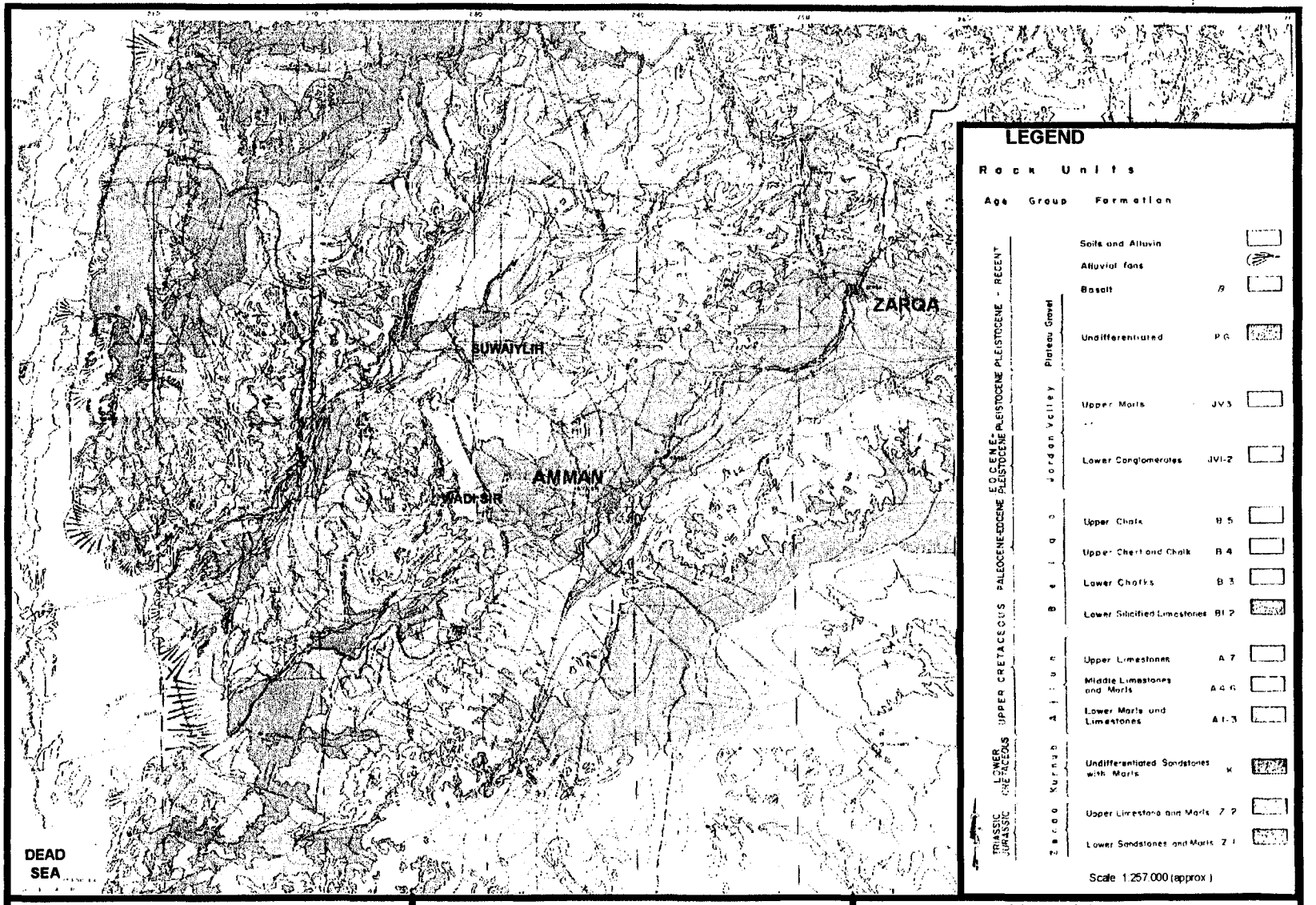

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Figure 4.3
Geology of the Study Region

The alignments in this area would probably be constructed in both cut and fill. Cut sections should not be problematical as the rock has essentially horizontal bedding and material for embankment and fill may come from selected borrow areas available nearby, if found suitable. Otherwise material from quarries in the area will be required. Material for fill is available from the weathering of the Belqa series.

Section 2 (W. Ush , ZTR and ZEBP)

This corridor passes through the Belqa B2 formation comprising, silicified limestone and chert, and the B1 formation, chalky marls and limestones. The strata along the corridor show gentle warping but in many locations are essentially horizontal. Faults occur but are not frequent.

The corridor runs along the flank of Wadi Madune and Wadi Ush. Side cuts will be required, but stability should not be a major concern. However, protection measures against falling debris may be required, (check Fences and Walls) particularly for cuts in the chalky marls and limestone, (B1 formation).

4.3.2 Structural Geology and Seismology

The structural geology of the study area is reasonably complex, with extensive fault systems and associated structures present, especially in the North of the study area in the vicinity of the Zarqa fault line. Overall, the structure is dominated by the northern extension of the NE - SW trending deformation belt of the Wadi Shuaib structure that comprises echelon folds, monoclonal flexures and folds.

Both the geology and seismic data indicate that most of Jordan is subject to earthquake risk, with the Dead Sea - Jordan Valley rift the most likely principal source of future events. Historical records, Table 4.4 and Figure 4.4 show magnitudes of up to m=6.2 have occurred in the Aqaba region with values in the range of m=4 to 5 more usual in the Amman area.

The National Jordanian Building Code divides Jordan into 3 zones. A, B and C as shown in Figure 4.5. According to this division all sections of road to be studied will fall in Zone B.

In the event that high viaducts are to be used, a more careful, site specific evaluation of the Pearl Ground Acceleration (PGA) should be undertaken.

4.3.3 Mineral Resources

There are two potentially exploitable mineral resources in the region. These are located east of the Northern Section of Section 2 as shown on Figure 4.6.

(i) Russeifa Phosphate Mine

This mining concession area contains both phosphates and uranium. Open Cast and underground mining was carried on at this site until 1987 when operations stopped primarily in response to a combination of :

- unfavourable mining and transport conditions
- opposition from communities living nearby.

Table 4.4 Historical Earthquake Data and Mean Return Periods

A Historical Record to 1899

Date	Time	Epicentre N - Easting	Intensity[1]	Mf[2]	Location
Major Events to 1899					
Circa 112	-	31 - 35	D	6.2	Dead Sea System
9/7/551	-	32 - 36	F	-	Dead Sea System
18/1/747	1000	31.1 - 35.7	F	-	Dead Sea System
5/12/1033	1800	32.4 - 35.5	F	-	Dead Sea System
18/3/1068	0830	23.5 - 36.7	D	7.0	Dead Sea System
20/5/1202	0700	33.5 - 36.0	S	-	Upper Jordan/ Litani
1/5/1212	0500	30.0 - 35.2	D	6.7	Dead Sea System
January 1293	-	31.0 - 35.6	D	6.6	Dead Sea System
12/11/1458	-	31.0 - 35.5	D	6.5	Dead Sea System
14/1/1546	1600	32.0 - 35.1	F (?)	6.0	Dead Sea System
4/1/1588	1300	29.0 - 36.0	D	6.7	Northern Hejaz
Events magnitude >4 since 1899					
11/7/27	1303	32.0 - 34.8	6.0	F (?)	Near Jericho
24/9/27	0027	29.0 - 35.0	4.9	F	N. Hejaz
12/5/34	1646	29.1 - 34.9	4.2	-	N. Hejaz
13/4/58	1202	29.0 - 34.8	4.0	F	G. of Aqaba
3/2/83	1346 and 2330	29.2 - 34.8	4.8	-	G. of Aqaba
31/12/85	1942	29.1 - 34.9	4.6	-	G. of Aqaba
18/10/87	0105	29.5 - 35.1	4.4	F	Near Aqaba

Notes: 1: F = Felt to strong (< VI MSK) , S = Strong = (VI to VII), D = Damaging (VII to IX)
2: Mf = Macroseismic magnitude determined from felt data

B Seismicity of the Levant Fault System, > 6.1 M

Date	Region	M	Date	Region	M
16/3/56	L	6.1	21/8/1042	D	7.2
1/1/1837	L	6.4	5/12/1033	L	6.5
1802	L	6.2	5/4/991	L	6.5
25/11/1759	L	6.8	847	L	6.2
30/10/1759	L	6.5	3/5/765	N	6.2
14/1/1546	N	7.0	18/1/746	NL	7.3
20/5/1202	NL	6.8	659	N	6.1
1201	L	7.4	June 658	N	6.6
1182	D	6.7	565	L	6.7
1160	N	6.1	419	L	6.2
15/7/1157	L	6.1	233	L	6.3
1151	D	6.2	130	L	6.3
24/12/1105	D	6.1	-30	N	7.0
1060	N	6.1			

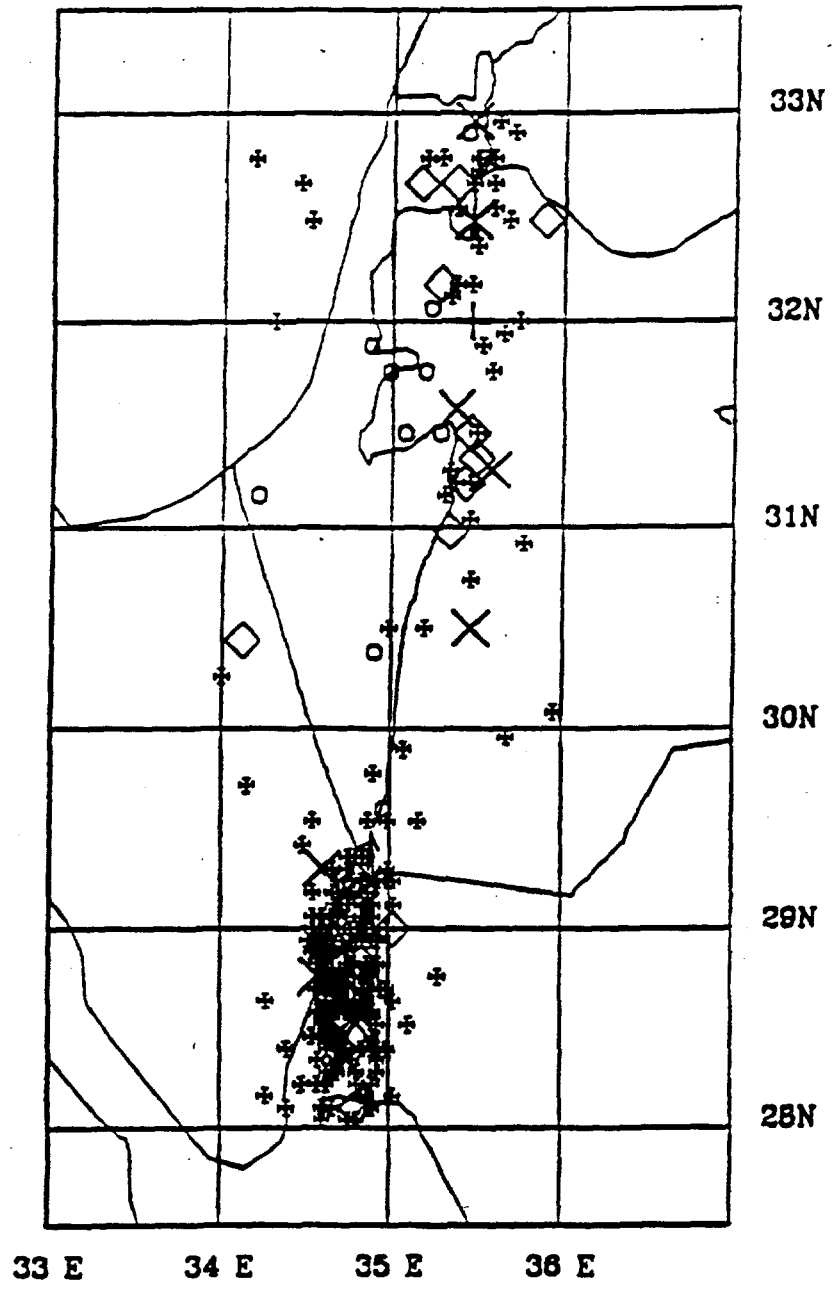
L= Galilee and Lebanon, N= Northern Dead Sea to Samara and Lake Tiberias, D = Secondary fault system

C Variation of Seismicity Along the Levant Rift Zone: 2000 BC - 1979 AD

Segment	Latitude (Spread Deg.)	Total Fault Length (kilometres)	Observed M_{max}	Mean Return Period (Years)
Galilee and Lebanon	32.9 - 34.6	190	7.4	- 1500
Northern Dead Sea to Samara and Lake Tiberias	31.3 - 33.0	190	7.3	2,300
Northern End	34.6 - 37.4	300	8.0	- 1400
Arava and South eastern Dead Sea	29.5 - 31.3	200	7.2	4300

Source: JRV Environmental Profile, (After Ben-Menahem and Aboodi, 1981)

First Date: 1566 BCE Last date: Sept. 26. 1994



Richter Magnitudes: 4 5 6 7 O Seismograph Station

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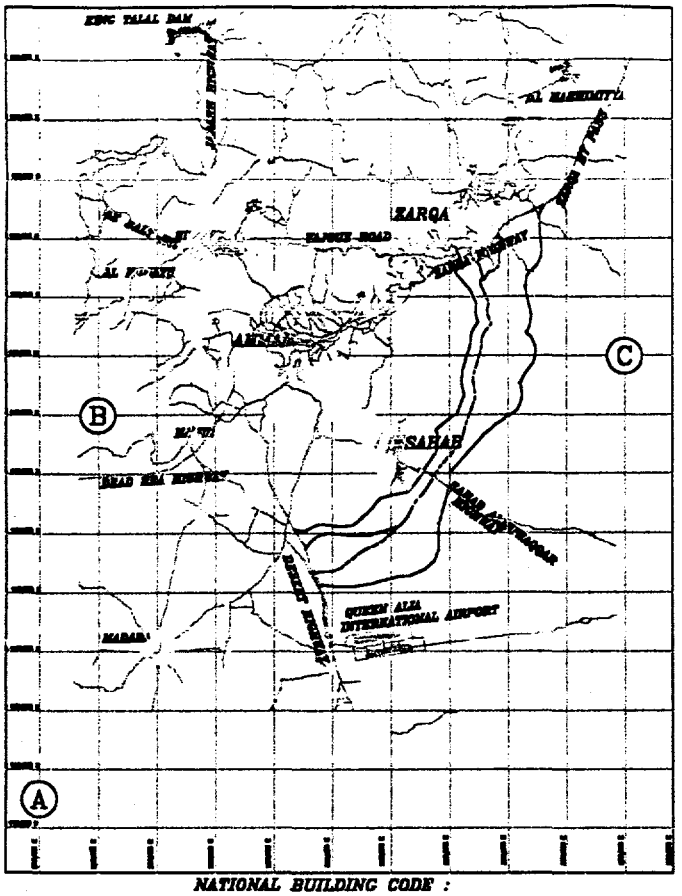
Figure 4.4
Historical Earthquake Data



NATIONAL BUILDING CODE : SEISMOLOGY ZONES

ZONE	SEISMIC INTENSITY (MERCALLI SCALE)	INTENSITY FACTOR
A	< 6	0.75
B	6 - 8	0.50
C	4 - 6	0.30

Note : For Mercalli Scale Definition Refer to Appendix D

LEGEND

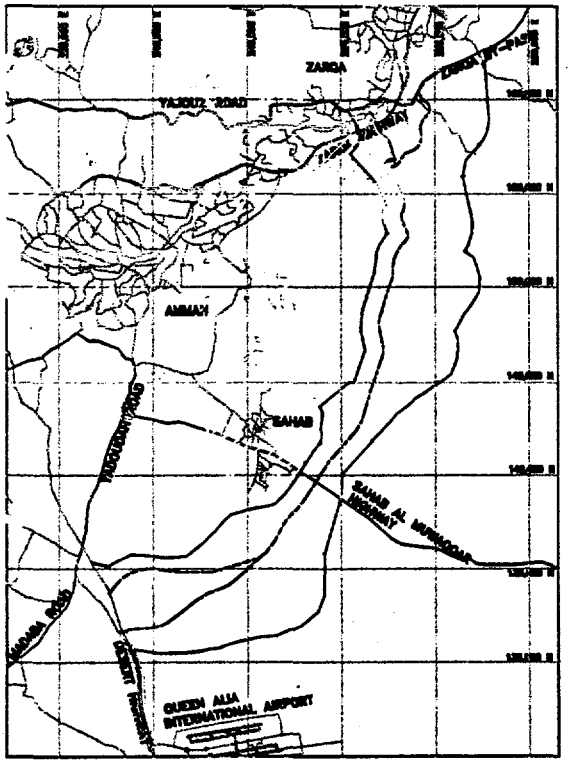
ALIGNMENT CORRIDOR

SEISMIC ZONE BOUNDARY

ZONE REFERENCE (A)

0 1km N

FIGURE 4.6
NATIONAL BUILDING CODE
SEISMOLOGY ZONES



LEGEND

PROJECT CORRIDOR

EXISTING QUARRIES

CONCESSION AREA

DESIGNATED QUARRY AREA

0 1 5km N

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FIGURE 4.6
MINERAL RESOURCES

Discussions held with the Mining company in May 1998 confirmed that the mining company do not intend to reactivate productive operations, but rather have drawn up plans for a large scale mixed commercial and residential development on the site.

(ii) Aggregate Quarries (Table 4.5)

A large area has been set aside by the NRA for the extraction of aggregate materials just to the west of the proposed alignment. This area comprises primarily outcrops of the Wadi Es Sir Limestone which, historically, has been extensively utilised as a building stone. Today, however, virtually all production is of aggregates. In recent years the procedure for operating quarries has changed and today operations are undertaken on the basis of rental of lands rather than ownership rights.

It is possible that the project will encourage further development of existing sites or new exploitation of resources through either, (or both);

- the creation of a short term, construction demand, or
- facilitating the exploitation of the reserves by the improving access and distribution options provided by the project.

Table 4.5 Quarry Production: Wadi Al-Qattar/ Wadi Al-Ush

	Category	Annual Production (m^3)
A	Abrasion <30%. Crushing strength in concrete 420 kg/cm^2	504,000
B	Abrasion 30 to 35%. Crushing strength in concrete 320 kg/cm^2	1,428,000
C	Abrasion 35 to 40 % Crushing strength in concrete 210 - 216 kg/cm^2	1,134,000
D	Abrasion 45 to 45% crushing strength in concrete 70 -140 kg/cm^2	1,134,000

Source: Geology Directorate 1997

4.4 TOPOGRAPHY, LANDFORM, SOILS AND LAND SUITABILITY

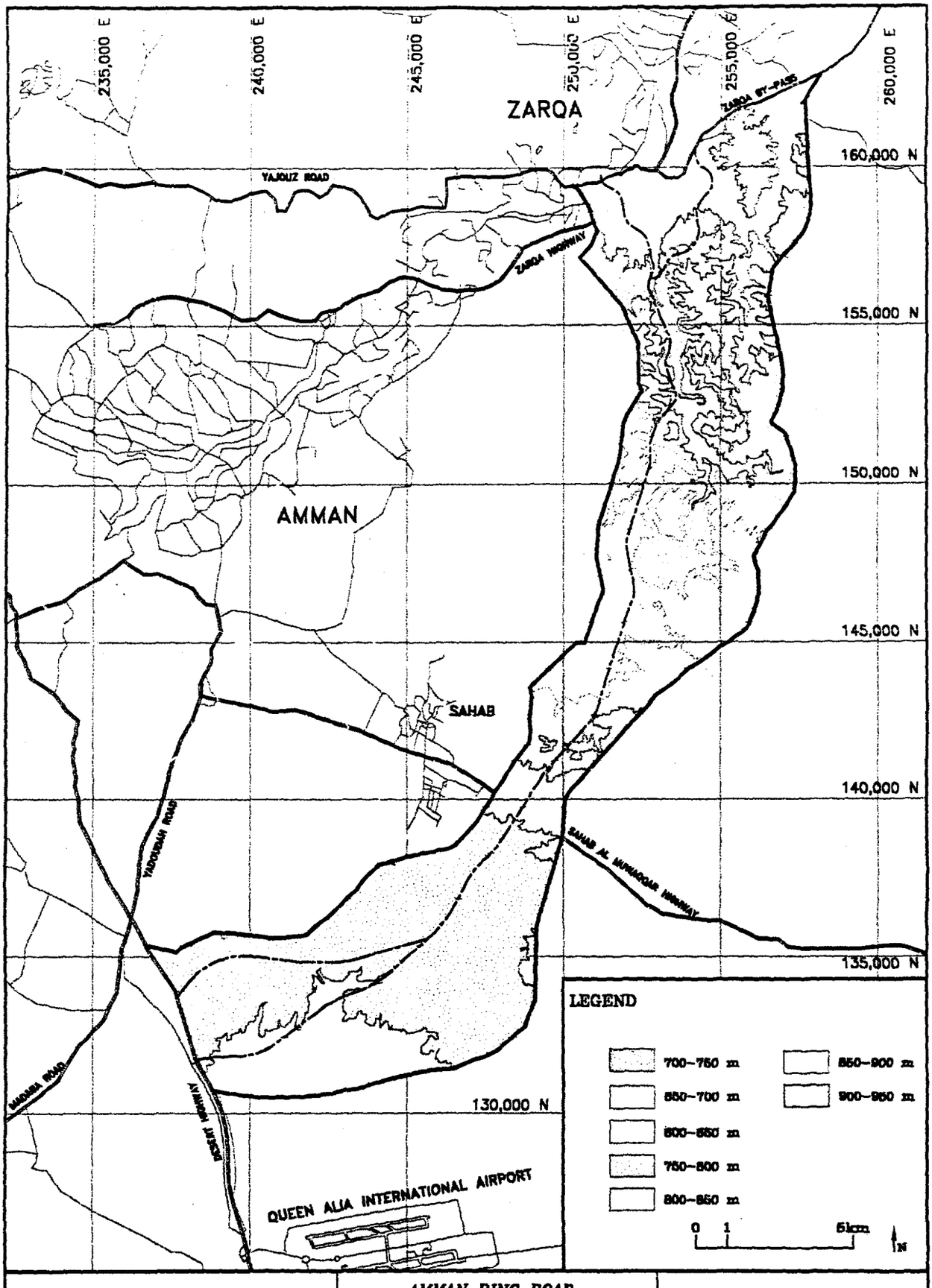
4.4.1 Topography and Landform

The topography of the road corridor is expressed in simplified terms in Figure 4.7 which clearly demonstrates the severity of some of the terrain encountered and its relative distribution.

The landforms of the study area are best described within the framework of the Land Systems analysis carried out for the NSMLUP. Brief summaries of the landform and land capability for each of the land systems crossed by the road corridors are provided below together with the location map and typical cross sections shown in Figures 4.8 and 4.9 respectively. In the context of the NSMLUP, the study area falls within the two regions noted below and indicated on Figure 4.8.

Region 8: Northern Highlands Dissected Plateau (NHDP)
Region 11: Jordan Highlands Plateau (JHP)

Some eight sub units are traversed, or are in close proximity to, the alignments. These are described below in order, moving broadly from south to north.


235,000 E
240,000 E
245,000 E
250,000 E
255,000 E
260,000 E
ZARQA
ZARQA BY-PASS
160,000 N
YAJOUZ ROAD
ZARQA HIGHWAY
155,000 N
150,000 N
AMMAN
145,000 N
SAHAB
140,000 N
YADOUDAH ROAD
SAHAB AL MUWAQQAR HIGHWAY
135,000 N
MADABA ROAD
DESERT HIGHWAY
130,000 N
QUEEN ALIA INTERNATIONAL AIRPORT
LEGEND
700–750 m
750–800 m
800–850 m
850–900 m
900–950 m
0 1 5km
N
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BAR AL-HANDASAH
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FIGURE 4.7
TOPOGRAPHY OF THE CORRIDOR

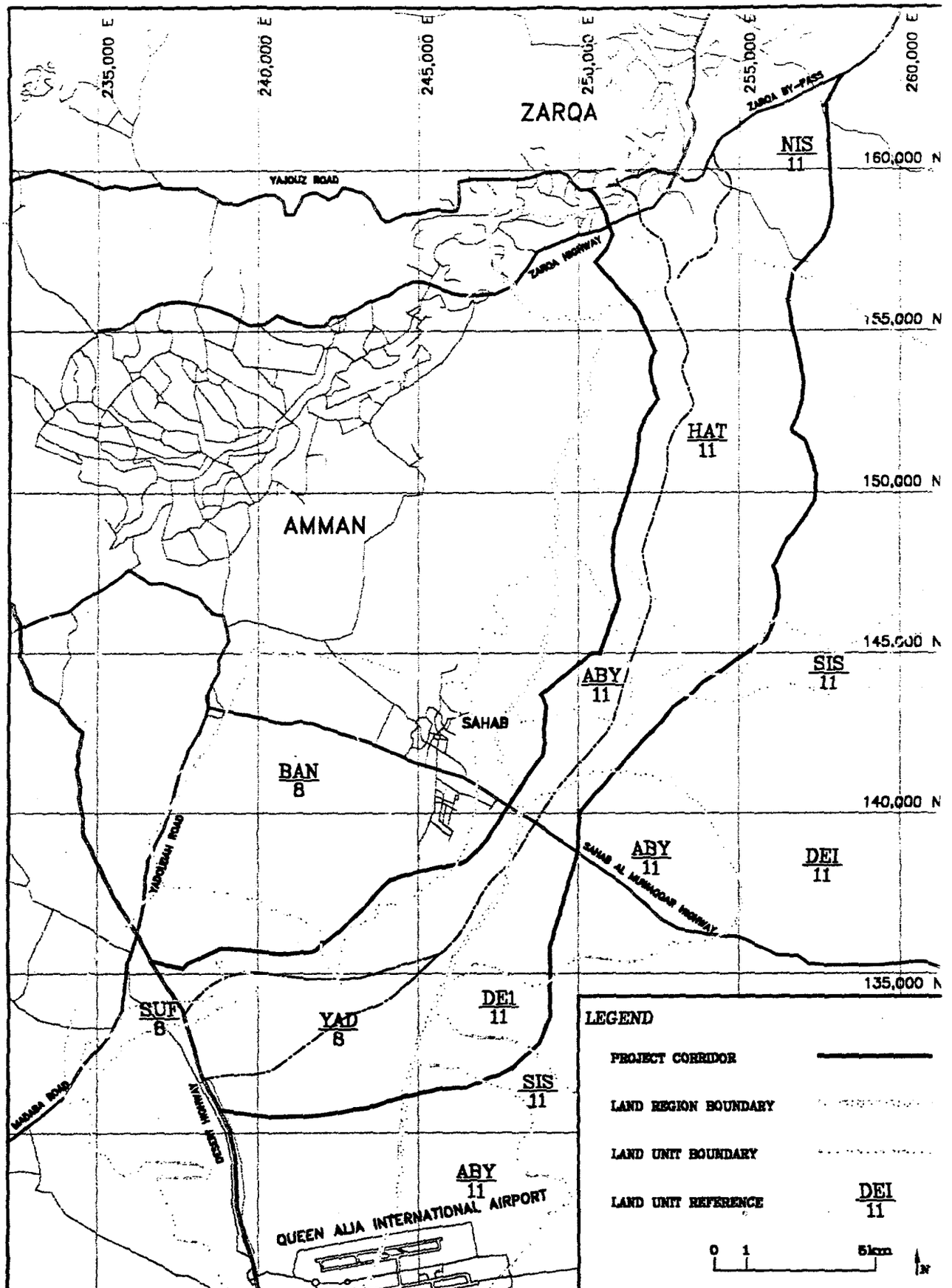

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FIGURE 4.8
LAND UNITS

Sufa (SUF)

This is a small unit that occurs in three areas on the periphery of the Madaba Plains being differentiated, only by greater development of the profile which is undulating to rolling in nature rather than gently undulating. Accordingly, it is essentially similar, comprising rounded hills, valley shoulders and long colluvium and loess mantled slopes.

The moisture regime is xeric though at <300mm rainfall is unreliable. Nevertheless agricultural activity is intense on the deeply mantled soils. Where uncultivated, the steeper slopes of the valley shoulders carry a grass cover of Mediterranean species.

Yaduda (YAD)

The Yaduda unit makes up much of the eastern portion of the Madaba Plains and comprises most of the Section 1 alignment under either option. It is typically a very flat undulating plain comprising deep colluvial / loessic fills mantling very low interfluves. The Plains in this area are only weakly incised by wadis.

Rainfall is generally too low to support rainfed agriculture though it is increasingly apparent that grasslands are being ploughed up. Where irrigation is present vegetable, flower and tree crop production is undertaken.

Hisban (BAN)

This is the most marginal of the units described here in that it lies generally to the north of the preferred alignment. It has some influence however in that Project drainage requirements in Section 1 will be dictated by and large by the discharge from the lands that comprise this unit. It occupies areas on the margins of the escarpment to the southern (River) Jordan Valley. It represents moderate dissection of the Belqa Limestone. Slope profiles are generally simple with only 3 facets evident; Broad, but irregular crests lying above moderately steep slopes mantled at least partially with colluvium, and wide infilled 'U' shaped valleys. The area lies between 750 and 950 m with moderate relief.

Some 55% of the unit comprises soils of greater than 50 cm depth that support most crops though groundwater irrigation is prevalent for summer crops despite the relatively high rainfall, 350 - 400mm. Off the valley floors tree crops are common with some cereal cropping on the less steep colluvial slopes. Virtually all natural vegetation has been removed though degraded Mediterranean grasses (Poterium spp) on steeper slopes provide for some grazing.

Abyad (ABY)

This is a gently undulating depositional plain of Quaternary alluvium and loessic materials overlying the Al Hissa Phosperites and the Muwaqqar chalks and marls.

The typical cross section for this zone shown in Figure 4.9A, indicates a relatively low energy environment with weak wadi incisions and an associated gentle relief. In general the unit lies between 750-950m.

Much of the area, some 70%, has been ploughed up for barley crop production (and occasionally wheat). though the marginal rainfall, (<150 mm) renders most production outside of valley floors marginal at best.

FIGURE 4.9

TYPICAL CROSS SECTIONS

YADUDA YAD

PHYSIOGRAPHY

Very gently undulating plain on Belqa Group Limestone mainly of Al Hisa Phospherite and Muwaqqar Chalk and Marl Formation. Deep colluvial/loessic fills (1) mantle the very low interfluves and gentle slopes. The plains are weakly incised by wadis flowing in broad shallow valleys (2). Altitude 700-730m with relative relief of <25m.

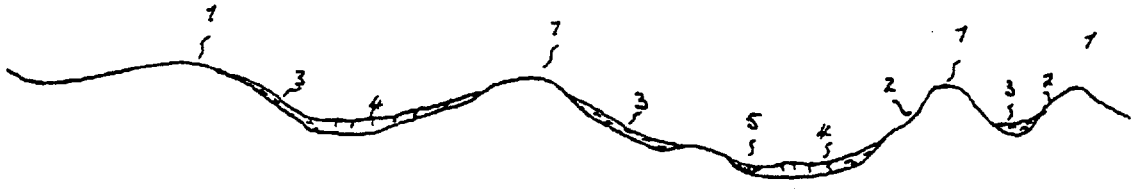
CROSS SECTION

MUDEISIS DEI

PHYSIOGRAPHY

Very finely dissected limestone and chert plateau on Umm Rijam Chert and Muwaqqar Chert and Marl Formations. Forms watershed of drainage flowing south west to Wadi Walla and north east to the Azraq Depression. Rounded hills and crests with occasional sharp ridges (1) with occasional steep upper slopes (2), alluvial and colluvial fans (3) merging down slope to coalesced alluvial fans infilling valleys (4): active wadis have gravelly channels (5).

CROSS SECTION

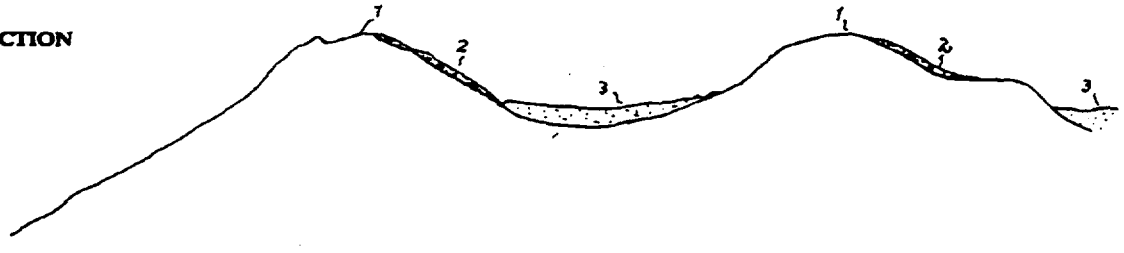


HISBAN BAN

PHYSIOGRAPHY

Undulating to rolling lands along the margins of the escarpment to the southern Jordan Valley. Formed by moderate dissection of Belqa Limestone Formation with broad, irregular crests (1), moderately steep slopes partially mantled with colluvium (2), and broad, infilled U-shaped valleys (3). Banded rock outcrops in facet (2). Altitude 750-950m, relative relief 50-100m.

CROSS SECTION



Soils in this unit are predominantly deep and fine textured but a high CaCo3 content promotes capping and slaking that in turn may hinder the uptake of trace metallics and cause nutrient imbalances in crops.

The destruction of the natural grass cover has made the fine soil cover extremely vulnerable to desiccation and wind erosion and, in the longer term, significant environmental damage can be expected unless effective land use management is introduced.

Mudeisisat (SIS)

The SIS unit forms a steep sloping eroded escarpment linking higher dissected plateau of the MUD and DUB units with the lower lying depositional plains of the ABY unit formed on Umm Rijam Chert and Muwaqqar Chalks and Marls.

The unit is dominated by shallow stoney soils, only 20% having a depth of greater than 50cm, and of this >50% are on slopes >10%. This combined with the xeric - aridic regime (increasingly aridic to the south east) restricts cultivation to the toe slopes and limited areas of valley alluvium where run off collects. The steeper slopes remain predominantly utilised for grazing.

Mudeisis (DEI)

Similar to the SIS unit, this area lies very much on the periphery of the Southern alignments. It is a very finely dissected chert plateau on the Umm Rijam Chert and Muwaqqar chalk and marls. It is a watershed unit draining south west to Wadi Walla and North East to the Azraq depression. Landforms are typically subdued, with rounded hills the norm. Occasional sharp ridges are however present.

The area is intensively grazed with the dominant steppe grassland vegetation kept very low to the ground even during spring. The xeric - aridic moisture regime restricts cultivation to valley floors where hill run off collects.

Soils on some lower slopes have fine loamy textured deep soils though these can have a high $CaCo_3$ content and a compacted sub soil structure that inhibits suitability for cropping. Salinity is occasionally evident though rarely of significance.

Qihat (HAT)

Much of the middle section of Project Section 2 traverses this unit. It comprises strongly and finely dissected rocks of Amman Silicified Chert and the Muwaqqar Chalk and Marls that produces steep sided hills with angular crests.

Barley is cultivated in valley bottoms and occasionally on lower slopes of colluvial benches and infilled alluvial valleys however the Xeric - aridic transition moisture regime (100 - 150mm) severely limits productive capability outside of the most favourably located (for collection of hill run off) valley floors.

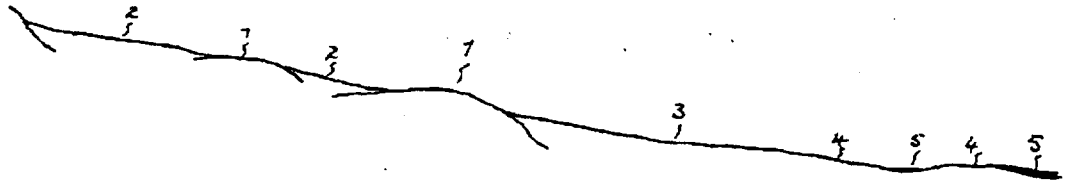
The valley alluvium and the colluvial deposits are suitable for irrigation on slopes of less than 10% and will also even support irrigation supplemented tree cropping.

ABYAD ABY

PHYSIOGRAPHY

Gently undulating depositional plains of Quaternary alluvium and loess overlying Al Hisa Phosphorite and Muwaqqar Chalk and Marl Formations. Weak wadi incision. Low, rounded interfluves of limestone and chalk (1) protrude through deeply colluvially mantled pediments (2). Extensive coalesced alluvial fans (3) slope gently down to toeslopes (4) around margins of wadi channels and Qa's (5). Altitude 750-950m: relative relief < 10m.

CROSS SECTION

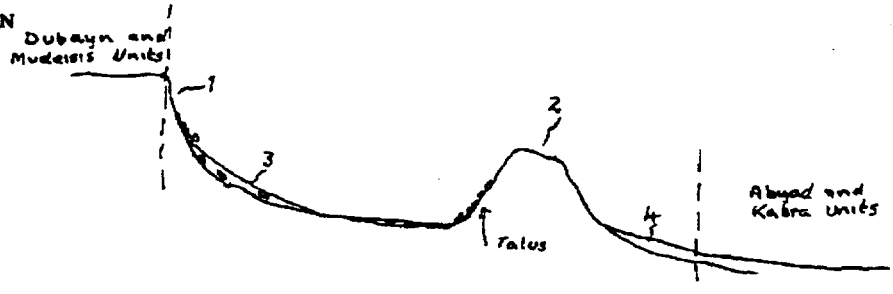


MUDEISISAT SIS

PHYSIOGRAPHY

Steeply sloping eroded escarpment linking the higher level dissected plateaux of the Mudeisis and Dubayn units with the lower lying depositional plains of the Abyad and Kabra units formed mainly in Umm Rijam Chert and Muwaqqar Chalk and Marl. Consists of steep escarpment faces (1) with isolated steep hills as plateaux outliers (2), steep stony colluvium (3) and low angle alluvial fans at the base of the slopes (4). Altitude 750-950m with relative relief of 100-150m.

CROSS SECTION

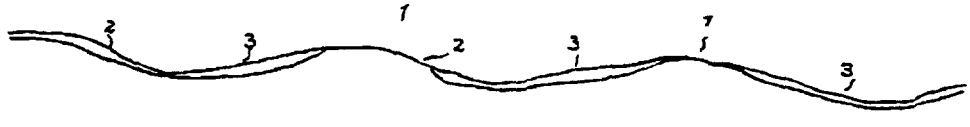


SUFA SUF

PHYSIOGRAPHY

Undulating to rolling terrain on Belqa Group Muwaqqar Chalk and Marl with local phosphate beds. Undulating, rounded hills on limestone (1), with steep valley shoulders in places (2), and long colluvium and loess mantled slopes (3). Moderately well developed dendritic drainage pattern.

CROSS SECTION



Nisab (NIS)

The NIS unit is a dissected plateau of Belqa Limestones that is, in the vicinity of Zarqa, fault aligned.

The area is xeric - aridic with only 100 - 150mm of rainfall and as a consequence cultivation is confined to the lower slopes of coalesced outwash fans and valley alluvium as noted on Figure 4.9C. Even in these areas, however only very poor yields, predominantly of Barley are obtained. Elsewhere the unit is dominated by intensively utilised grasslands though much of this valuable resource has been lost to ploughing.

Some 40% of the area is covered by deep fine loamy soils on gradients of less than 10%. that are suitable for irrigated production. However, these areas are largely unaffected by the Project which for the majority of the alignment in this unit is confined to the Wadi Ush valley sides.

4.4.2 Soils

The study area contains the four broad soils groups shown in Figure 4.10, namely:

- Mafraq Jiza Soils: Calciorthids with subsidiary Camborthids

  These soils are extremely vulnerable to erosion when disturbed and measures to reduce surface flow are advisable. Protection against overgrazing may also be required. If irrigation is proposed salt leaching and modified drainage may be necessary.

- Zarqa and Al Hussainiya Soils: Calciorthids with subsidiary Camborthids

Soils of this type are extremely vulnerable to pulverisation by heavy machinery which leads to decreases in permeability that in turn increase run off, salinity and erosion. Shallow soils on steeper slopes are particularly vulnerable to erosion.

- Qasr El Tuba and Zuwait Soils: Claciorthids with subsidiary Torriorthents

  These are generally poor soils not suited for cultivable use. They are vulnerable to overgrazing and erosion when surface vegetation layers are removed.

- Irbid Soils (On Gentle Slopes): Chromoxererts with subsidiary Haploxeralfs (on slopes >5%).

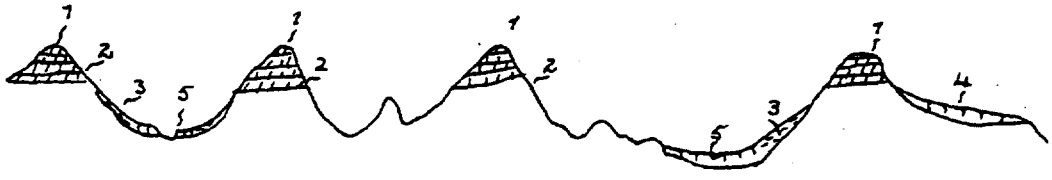
  These are deep, high quality soils that crack when dry and which therefore require effective management, especially in the maintenance of optimum moisture conditions. They are, in particular, vulnerable to puddling which destroys soil structure, when worked wet and with heavy machinery. In some areas these soils have a higher than normal montmorillonite content and strongly exhibit the swelling and shrinking properties of this clay. This may need to be addressed in detail during the design process.

QIHAT HAT

PHYSIOGRAPHY

Strongly and finely dissected rocks of the Amman Silicified Chert and Muwaqqar Chalk and Marl Formations. Produces steep sided hills with angular crests (1), steep rocky, banded upper slopes (2), colluvial mantles on middle and lower slopes (3), occasional colluvially mantled plateau remnants and broad crests (4), and alluvially infilled valleys (5). Altitude 650-850m, relative relief 50-100m.

CROSS SECTION

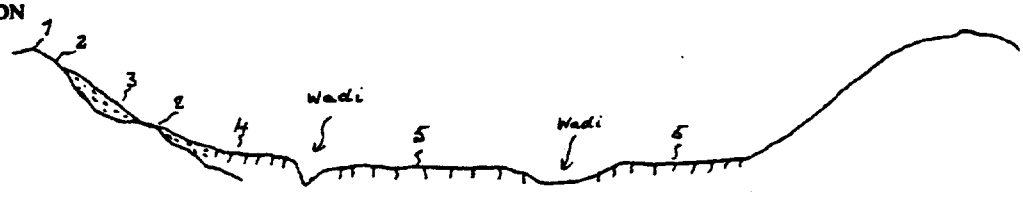


NISAB NIS

PHYSIOGRAPHY

Dissected plateau on Belqa Group Limestones, partially fault aligned in the Zarqa area. Consists of narrow interfluve crests (1) with steep short upper slopes (2), long, concave middle slopes with colluvial loessic mantle (3), coalesced alluvial fans of lower slopes (4), which merges into wadi fill alluvium (5): facet (5) in the north merges into the Hallabat unit. Altitude 550-750m, relative relief 100m.

CROSS SECTION



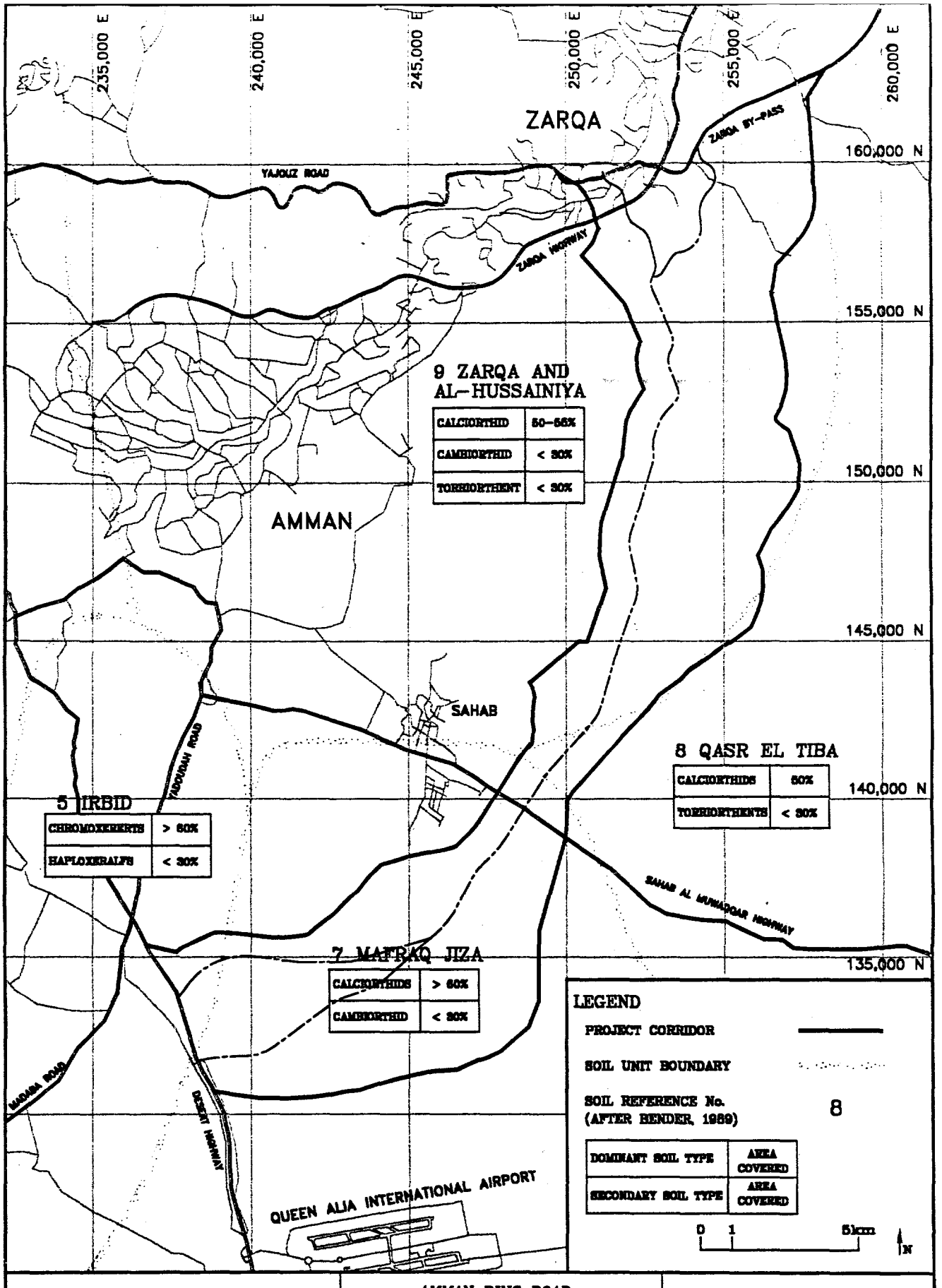


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FIGURE 4.10
SOIL UNITS

4.4.3 Land Suitability

The NSMLUP undertook a land suitability analysis for each of the soil mapping units for each of Rainfed Annual Cropping, Rainfed Perennial Cropping and Irrigation Use.

The criteria utilised in the assessment process is shown in Appendix E to this report. The principal findings of that assessment, shown in Tables 4.6 and 4.7 are quite clear:

Table 4.6 Summary of Land Suitability Analysis for Crop Production

	Rainfed Annual Production				Rainfed Perennial Prod.				Irrigation			
	% Area	Area km^2	Classific	Constr	% Area	Area km^2	Classific	Constr	% Area	Area km^2	Classific	Constr
Section 1												
ABY									75	600	1	
DEI									25	175	2	st
NIS									35	115	2	st
BAN	55	150	2	ts	60	165	2	cs	20	55	2	st
SIS												
HAT												

c = climatic; s= soil limit; t = topographic; unspecified = Not suitable
Source: NSMLUP

Table 4.7 Summary of Land Suitability as Rangelands

	% area	Area (km^2)	Notes
11			
ABY	40	320	p
DEI	65	450	
HAT	55	70	
NIS	40	125	p
SIS	60	120	
YAD			
NIS			
BAN			

p Denotes significant areas of grazing land ploughed up
Source: NSMLUP

- Climatic constraints determine that lands east of the desert highway are unsuited for rainfed agriculture but many are well suited for irrigation should adequate water resources be made available.

- Without irrigation the areas have substantial value as rangelands though this resource is in many areas being rapidly lost to ploughing and urban development though the latter is far less significant at this time.

Figure 4.11 shows the distribution of the land suitability classes across the study region.

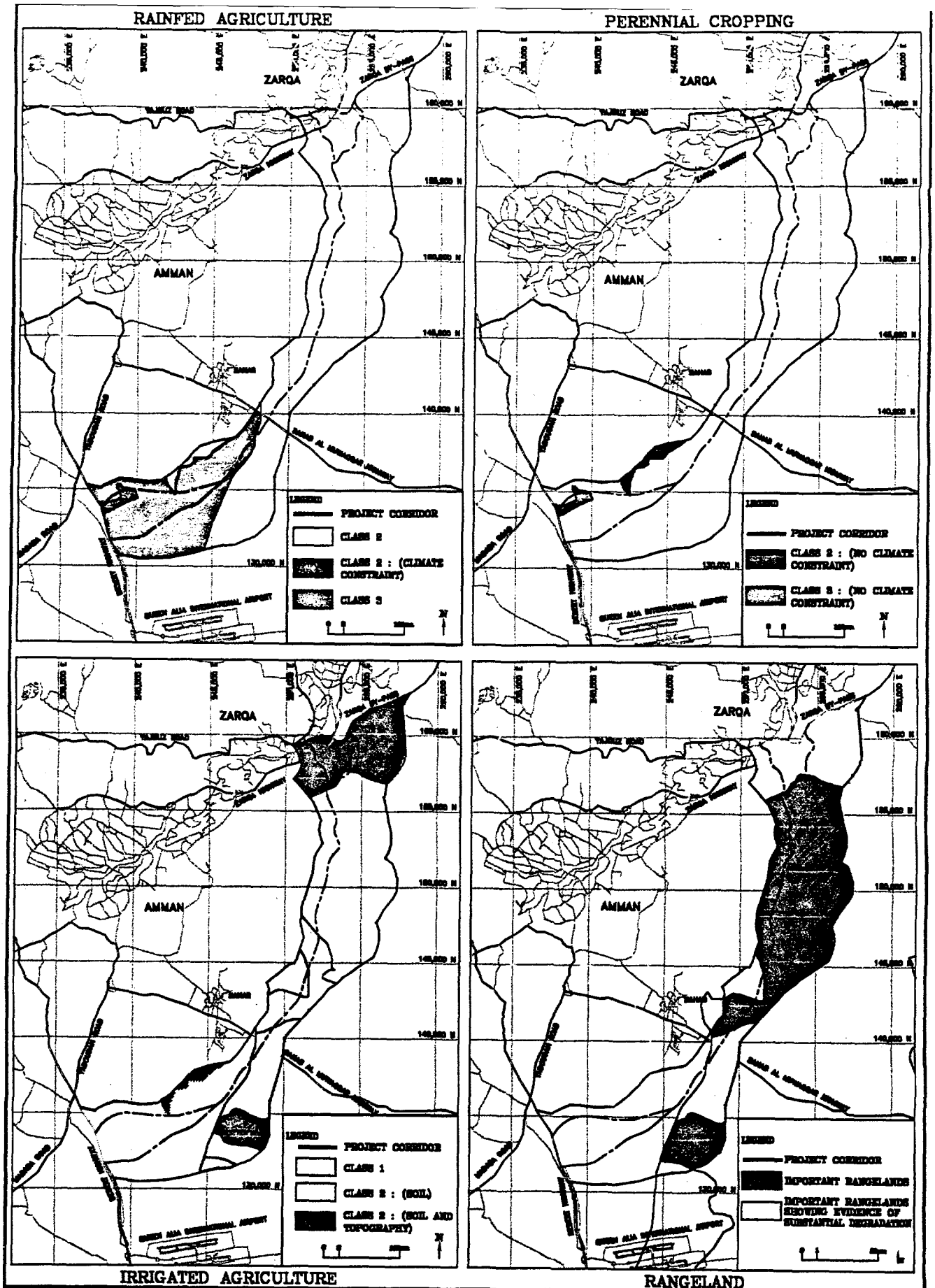

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FIGURE 4.11

LAND SUITABILITY MAPPING

4.4.4 Landscape Quality

In the absence of defined areas of natural beauty[1] any assessment of landscape quality will, by necessity, be subjective. Nevertheless, it is apparent to the Consultants that the quality of the landscape does not vary greatly.

For assessment purposes three criteria were utilised

- Interest: In effect the interest of the landscape as reflected by its particular composition;
- The extent to which the landscape has been urbanised or conversely the status and structure of the landscape;
- The condition of the landscape.

(i) Desert Highway - Muwaqqar Highway:

This section of the corridor offers only a flat, dry, featureless agricultural landscape with little obvious structure or merit.

(ii) Muwaqqar Highway - Wadi Ush Chemical Factory

North of Muwaqqar, the landscape changes significantly with hilly sections that offer views overlooking the plain to the south and east towards Sahab and Amman. From a visual perspective these hills while pleasant and offering some concept of 'wildness' are not out of the ordinary and compare unfavourably with other areas in Northern Jordan.

There are some cultural values to be considered. These are derived from the relationship between the landforms of the area and the archaeology, most notably in the location of the watchtowers that can be seen on high points of the Wadi Ush interfluve. There are also a number of other archaeological sites in Wadi Ush but these are largely undeveloped and to an untrained eye, add little to landscape.

(iii) Zarqa Industrial Area

This is a particularly unsightly industrial area that is in urgent need of an environmental clean up.

(iv) Zarqa Urban Area

The landscape of the Zarqa urban area affected by the Project (ZTR) has little or no residual value. It comprises an ad hoc mix of relatively low quality urban development, industrial complexes and utilities.

[1] As recognised by the endowment of an area with a specific status, e.g. Area of Outstanding Natural Beauty.

4.5 FLORA AND FAUNA

There are no protected areas within the Project Affected Area nor are the Consultants aware of any proposals for establishing such sites. Nevertheless, all the habitats within the study area are fragile and thus easily degraded and contain a number of rare and endangered species.

4.5.1 Flora

With annual rainfall in the range 100-300 mm, most of the project corridor lies within the Steppe Vegetation Region though 'transitional' Mediterranean spp. are apparent in the highest rainfall areas in the west and at higher elevations.

Two general vegetation types are present, Steppe Grassland (SG) and Artemesia Brush Steppe (ABS).

- Steppe Grassland

Principal constituent species of the SG are *Poa sinaica,* and *Carex pachystylis* which form a shallow root mat that in good condition provides very effective protection against erosion. However, repeated overgrazing will break down the turf and lead to rapid aeolian and water erosion of the, vulnerable, silty soils. Once destroyed the root mat reforms only very slowly even under optimal, protected conditions. It is significant that in recent years substantial areas of turf have been destroyed by ploughing.

Under natural conditions, the SG would occupy a wide range of terrain; undulating alluvial flats, dissected limestone plateau, the boulder strewn basalt plateau and steeply sloping limestone hills. However, in the face of the spread of cultivated lands it is not uncommon for these communities to now be confined to the upper slopes of the limestone plateau.

- Artemesia Brush Steppe (ABS)

The ABS is dominated by *Artemesia herba-alba,* often associated with a thin mat of *Poa sinaic,* and *Carex pachystylis.* In its natural form, the density of Artemesia is a function of rainfall, with dense cover on crests, slopes and valleys in higher rainfall areas and more restricted occurrences, generally in valley floors and lower slopes, in the drier areas. These areas have been badly affected by recent overgrazing.

Table 4.8 provides a summary of the distribution of natural vegetation communities and their status in the Study Area by Environmental Unit. A summary map is also provided as Figure 4.9.

Data obtained to date and site investigations indicate that there are no habitats in the Project Affected Areas that support significant plant communities that are, globally, regionally or locally threatened.

4.5.2 Fauna

The avifauna of the study region is particularly diverse due largely to its relative proximity to the major bird migration route down the Rift Valley. Among the estimated 143 bird types that

may be found in the region are some 18, identified in Table 4.12, that are either globally threatened or regionally declining with the majority (13) globally threatened.

Table 4.8 Summary of Natural Vegetation Occurrence and Status

Unit	Comments
Region 8 SUF	Peripheral to the direct impact area, the steeper slopes of the valley shoulders may carry a grass cover of degraded Mediterranean species. Further loss possible but long history of cultivation suggests that those areas uncultivated now will remain so.
BAN	Similarly peripheral the upper slopes of this unit may carry degraded Mediterranean shrub associations primarily *Poterium spp* remain a significant source of browsing and grazing. These declining resources are under increasing threat from urban expansion.
YAD	Part of the transitional Mediterranean Steppe zone. The *Poa* and *Carex spp* steppe grasslands contain some Mediterranean spp and are heavily grazed. These valuable rangelands are being ploughed under and will increasingly be vulnerable to urban development.
Region 11 ABY	Predominantly Steppe grassland of *Poa* and *Carex spp.* Denser shrub cover occurs in some valleys and on Q'a margins. 70 % of grassland ploughed for barley and (occasionally) wheat.
DEI	Grassland steppe with *Poa* and *Carex* dominant. *Artemesia spp* dominant on steeper slopes. Limited threat beyond over grazing
HAT	Natural vegetation is heavily grazed *Poa* and *Carex* grassland with *Artemesia spp* on steeper slopes. Limited threat beyond over grazing.
NIS	Grassland steppe off the lower slopes of coalesced gravely fans and valley alluvials. Increasingly significant losses to ploughing.
SIS	Steeper slopes are mainly Brush Steppe dominated by *Artemesia* with *Poa* and *Carex* on lower colluvium slopes and alluvial fans. Limited immediate threat beyond over utilisation.

Table 4.9 Threatened, Endangered and Rare Species

A. Avifauna: *Globally Threatened Species*

Species	Distrib. (Box)	Common Name	Residence Status
Aegyptus monachus	5	Black Vulture	Visitor
Anas platyrynchos	4	Mallard	(B) Breeding ?
Aquila heliaca	5	Imperial Eagle	
Calidris minuta	45	Little Stint	
Charadrius alexandrinus	4	Kentish Plover	Breeding
Childonias leucopterus	4	White Winged Black Tern	
Chlamydotis undulata	5	Houbara Bustard	B
Ciconia ciconia	45	White Stork	Passage Migrant
Crex crex	5	Corncrake	PM
Fulica atra	5	Coot	(B)
Himantopus himantopus	45	Black Winged Stilt	PM
Pterocles alchata	4	Pin-tailed Sandgrouse	(B)
Recurvirostra avosetta	6	Avocet	B

Avifauna: *Regionally Threatened or Declining Species*

Species	Distrib. (Box)	Common Name	Residence Status
Aythya nyroca	4	Ferruginous Duck	PM
Bubucus ibis	4	Cattle Eagret	V
Falco biarmicus	4	Lanner	PM
Hippolais languida	6	Upcher's Warbler	PM
Neophron percnopterus	45	Egyptian Vulture	B

B. Mammals and Reptiles: *Endangered*

	Distrib. (Box)	Common Name	Habitat / General Notes
Canis lupus pallipes	56	Northern Middle East Wolf	Lives in mountainous areas overlooking Jordan Valley
Caracal caracal schmitzi	5	Lynx	Hunted to the point of extinction in Jordan. Only small numbers remain. Found on rough bare mountainous regions and often roams desert edge but never to the interior
Martes foina syriaca	4	Stone Marten	Related to weasels martens inhabit valley areas extending from Wadi Sir to the area surrounding the Kafrein Dam. Also known to inhabit pine forests and sometimes can be found on rocky open hillsides
Meles meles	4	Badger	Found in forest and mountain regions and is now very rare
Chamaeleo chamaeleon recticrista	45	European Chamaeleon	
Coluber mummifer	5	Coin Marked Snake	Relict Species.
Testudo graecaterrestris	5	Spur thighed Mediterranean Tortoise	Victim of the pet trade.

Rare

	Distrib. (Box)	Common Name	
Herpestes ichneumon ichneumon	4	Egyptian Mongoose	Found in forests and extensive olive groves
Rhinolophus ferrumequinum	4	Greater Horseshoe Bat	

Source: Varied: From National Biodiversity Study Documentation, NEAP, NES.

However, as Figure 4.13 shows, the distribution of bird species is by no means even with the western and central sections dominant due largely to proximity the rift valley migration route with its water sources and the waters of the Zarqa river. The influence of these physical features is significant in that they may give an exaggerated view of the density of species and the numbers of endangered / threatened species that may be affected by the project given the relative distance of the project corridors from these primary features

A similar picture emerges with regard to the reptiles and mammals though in these cases the diversity, as would be expected is much less. The proportion of mammalian species that is threatened is however unusually high, probably reflecting the biogeographical significance of the region in containing the southernmost incidences of Mediterranean forest and associated habitats.

During Project site visits the only sighting of interest was of a fox (sighted in May 1998). Full listings of the Bird, Mammal and Reptile occurrence in the study region are provided in Appendix F.

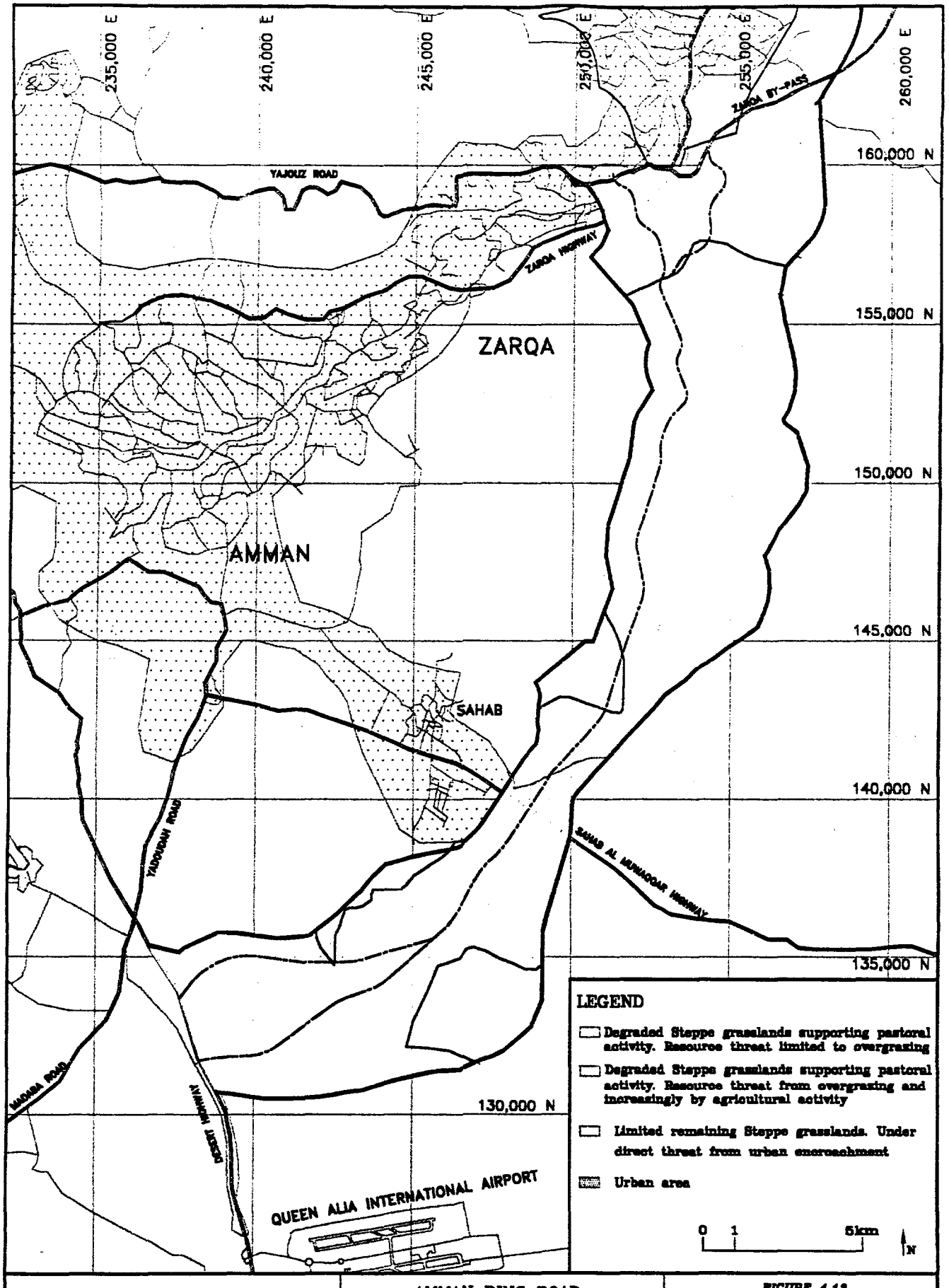

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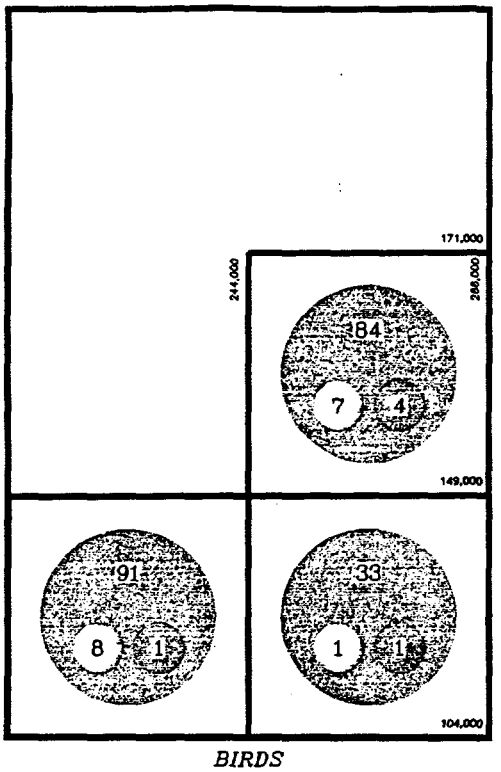
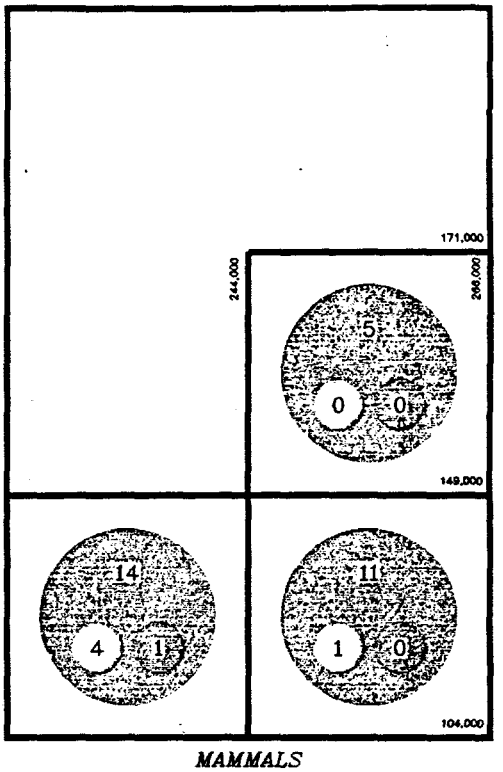
FIGURE 4.12

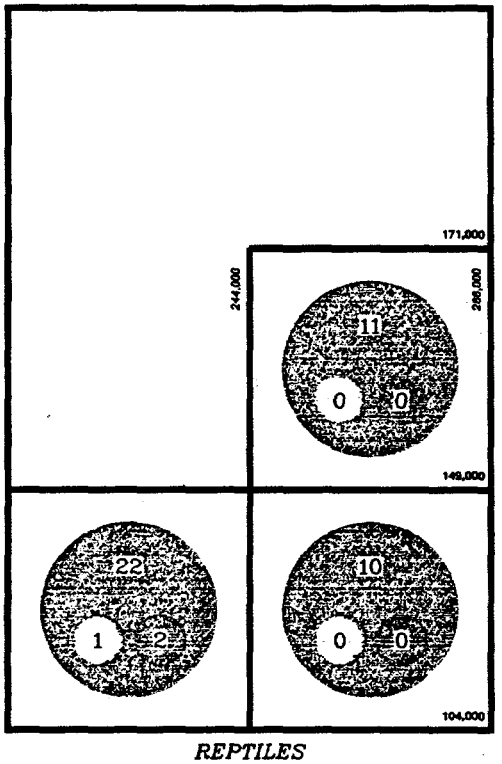
NATURAL VEGETATION STATUS



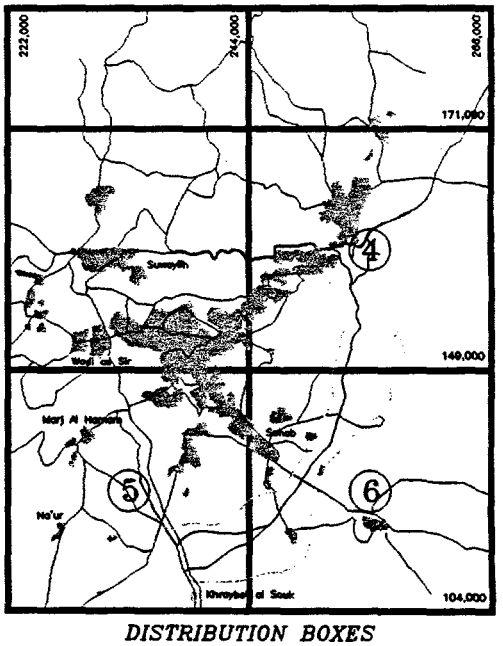
BIRDS



MAMMALS



REPTILES



DISTRIBUTION BOXES

LEGEND

Alignment Corridor

No. of Species Present

No. of spp. Globally Threatened / Endangered

No. of spp. Regionally Threatened / Declining

0 4 20km N

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FIGURE 4.13

FAUNA DISTRIBUTION

4.6 SURFACE WATER RESOURCES

4.6.1 Catchment Characteristics

The project area drains to two major drainage basins, the Dead Sea and the Jordan River, via a number of catchment types. These are described below and shown on Figure 4.14.

(i) Dead Sea Basin (Wadi Wala Catchment)

Eastern and southern areas of Section 1 drain south and south east to the Wadi Wala Catchment. This is a large catchment draining a significant portion of the Mid Region of the country. In the study area it is represented primarily by the northernmost extension of the Madaba Plain and thus flat to rolling terrain. Except in the immediate vicinity of isolated hill lines, the catchment has relatively gentle slopes that give rise to a low energy environment. In some areas, the flat topography is evidenced by frequent ponding from winter rainfall.

Drainage of the alignments will be from headwaters where the drainage pattern is dendritic and relatively sparse giving rise to relatively large sub catchments. No individual major drainage feature is apparent but there are two or three features indicated on Figure 4.14 that exhibit some, limited erosive characteristics.

All drainage features in these catchments (within the Project Area) are seasonal but do not flow every year.

Proposals have been developed in the past for a dam in this catchment about 10km upstream of the Kerak Road Bridge some 15 kms south of Madaba. Small perennial basal flows are present at the bridge but absent at the proposed dam site and in headwaters. The yield of such a dam is estimated at between 11.3and 13.2 MCM per annum for a storage of between 65 and 60 MCM[2].

Water quality measurements taken 20 years ago indicated good quality waters of low TDS of 200ppm.

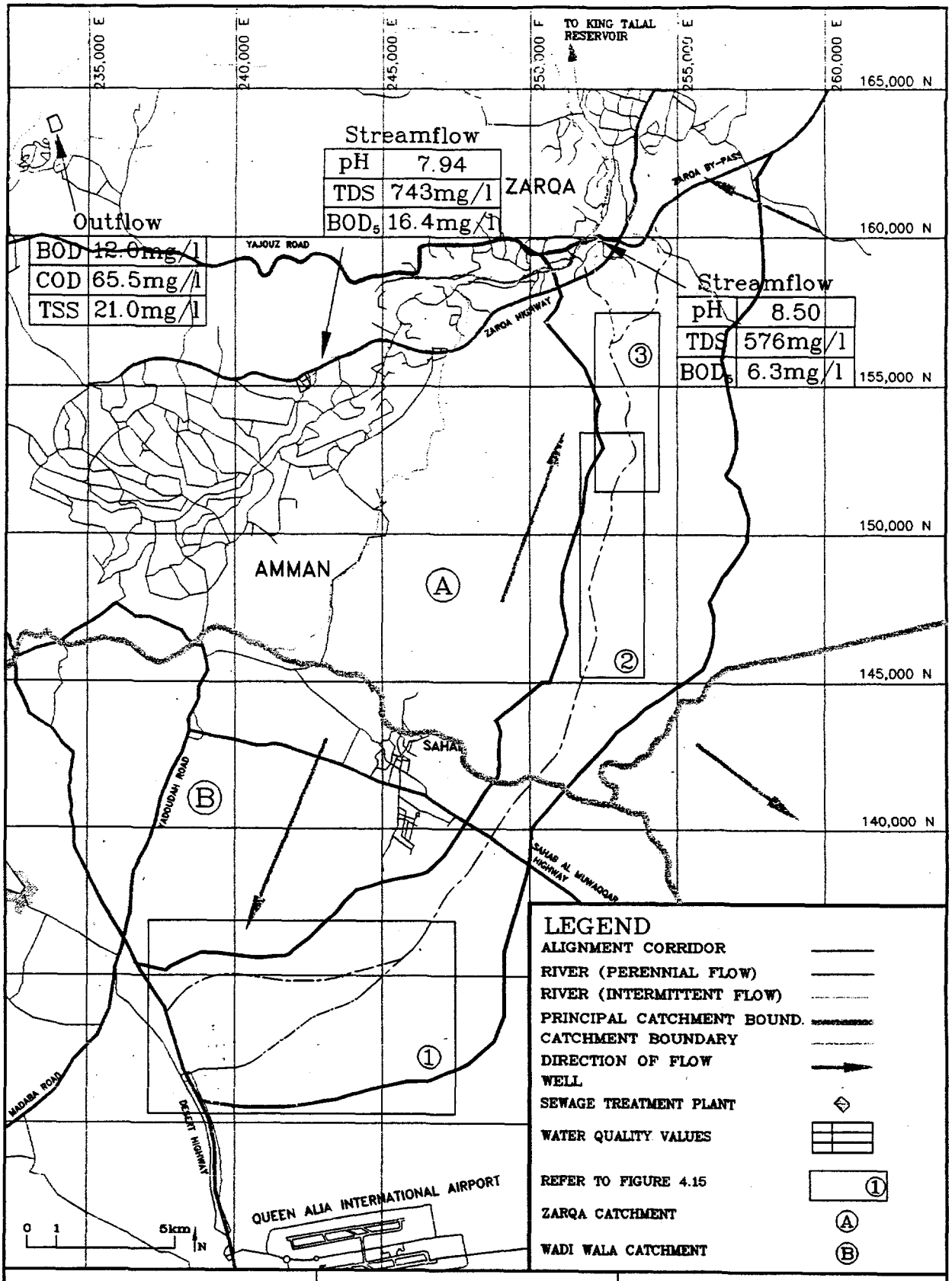
(ii) Jordan River Basin (Zarqa Catchment)

The mid and northern sections of the alignment drain to the Jordan River via the Zarqa Catchment. As indicated on Figure 4.14, the Zarqa Catchment is broken down into two sub units for review purposes.

(a) Wadis Abdoun and Sagf Al Sail drain the Amman urban area to the east towards Zarqa. They are traversed by the alignment corridor only at their easternmost in Zarqa (ZTR).

(b) Wadi Ush and Wadi Qattab. This flows virtually due north and drains virtually all of Section 2.

[2] These are net yields, i.e. inclusive of evaporation, for a 50 year drought return period.



DAR AL-HANDASAH

AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 4.14
PRINCIPAL HYDROLOGICAL FEATURES

Drainage patterns in these catchments typically comprises short headwaters (of 500 to 2.3 kms length) leading directly to the main channel. Profiles are moderately well developed in the upper reaches but rapidly fan towards to the main channel, (Figure 4.15).

The main channel has a somewhat surprisingly mature meandering long profile (given the severity of the relief) with a (relatively) wide valley floor. This is however often incised by the main channel. This is most marked in the northern section near the Zarqa Highway where 'cliffs' of 10m plus occur.

No channel in these catchments has perennial flow and in general flows are recorded only after periods of most intense rainfall. The main Zarqa river channel is perennial east of Sukhna spring.

Water qualities in the catchment vary significantly depending on location. Flows from the Amman areas, from catchment (a) on Figure 4.14 are clearly contaminated and have BOD5 / COD levels that are elevated. pH and NA levels are also above limits. Downstream at the Wadi Ush confluence some parameters have returned to more tolerable levels but pH levels rise and at 8.5 are high.

4.6.2 Impoundments

King Talal Dam

All flows from sub catchments within the Zarqa Basin that may be affected by the project will be impounded at the King Talal Dam. The flow distance between a probable Project drainage discharge and the reservoir is some 46 kilometres.

Downstream of Zarqa however, water qualities are understood to deteriorate markedly from a combination of urban run off, industrial activities, agricultural use and wastewaters from the Khirbet Samra treatment plant. However, the severity, and to a lesser extent, the nature, of the contamination of the waters retained in the reservoir is a source of some controversy.

Although the waters from the King Talal Reservoir (KTR) are used only for irrigation purposes a number of studies in the early 1980s seemed to suggest that the Zarqa river carried large quantities of heavy metals[3] to the reservoir. This prompted the JVA who are responsible for the KTR to undertake, (with the RSS) a detailed study to investigate to establish the true picture. This study concluded that:

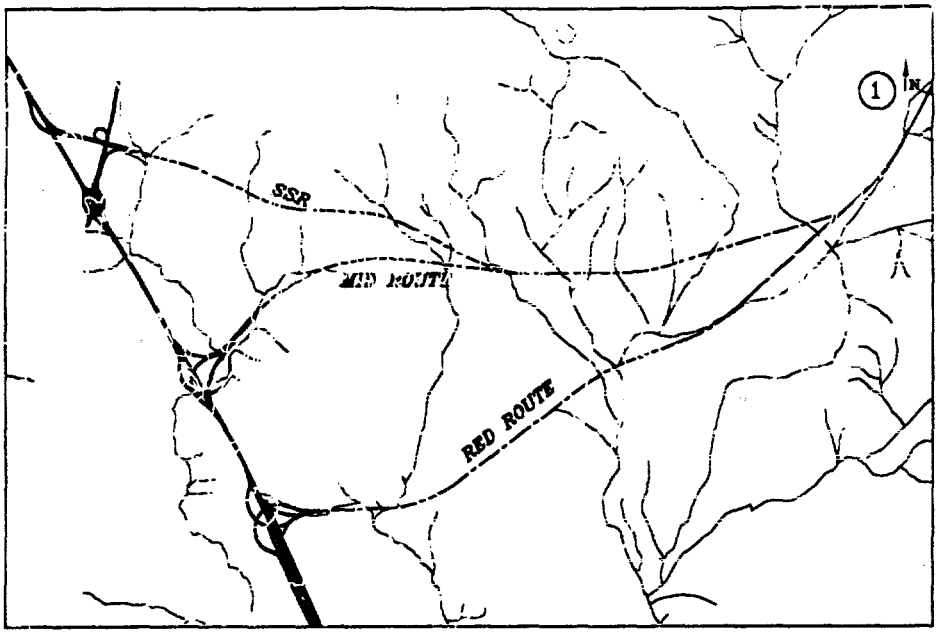
- Heavy metal concentrations in KTR sediments are within normal bounds for natural soils for all metals except cadmium and zinc which are considered to be bound together geologically.

- Elevated nitrate levels are found and considered to originate from the Samra Treatment Plant.

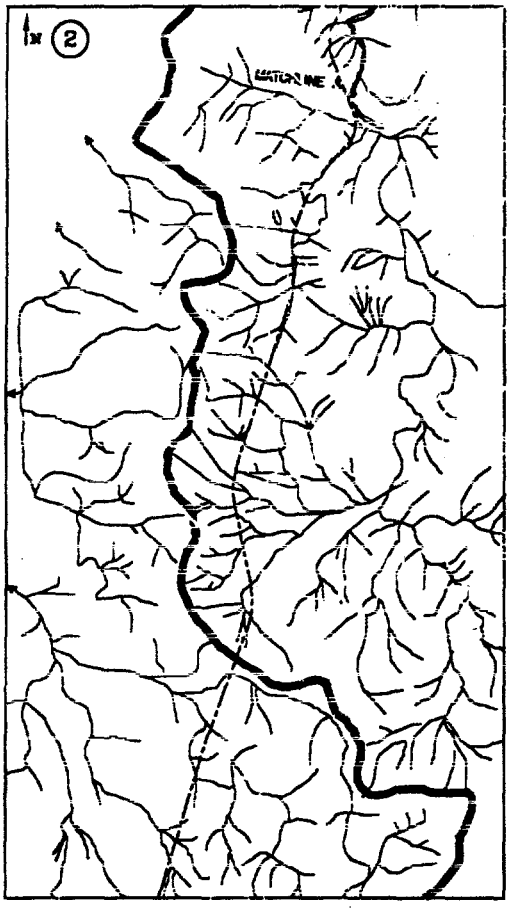
- The STP also contributes saline (mainly sodium and chlorine) ions to the reservoir waters

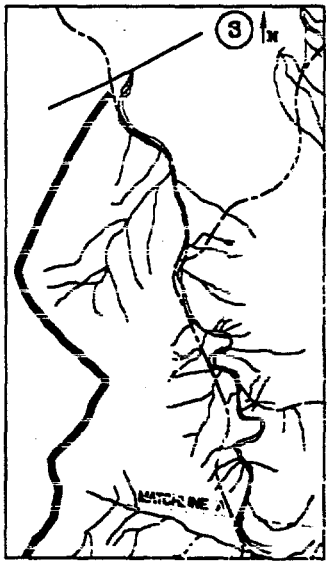
[3] Including trace elements, mercury, cadmium, selenium, nickel, lead, and arsenic, derived from site run off, wastewater discharge and air borne contaminants

DEAD SEA DRAINAGE BASIN



ZARQA BASIN





LEGEND

ALIGNMENT

CATCHMENT BOUNDARY

WADI COURSE

0 1 5km N

DAR AL-HANDASAH = DAR AL-HANDASAH

AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 4.16

TYPICAL DRAINAGE PATTERNS

Private Impoundment

A landowner has dammed Wadi Ush at a site some 0.65 kms south of the proposed Zarqa Highway interchange where the main channel is locally incised.

The waters from this site are utilised to irrigate a moderately sized orchard. No data is available on the water quality in the impoundment or it hydrological history; maximum flood, period of use, rates of sedimentation etc. This dam is illegal in so much as no permissions have been granted by WAJ though it is not known whether other permissions, for example from Zarqa Municipality have been granted.

4.6.3 Spring Flows

The study area contains a number of significant springs of varying yield that have in the past been used both for private and public water supplies but as is noted in Table 4.10 most are now effectively dry.

Table 4.10 Principal Springs in the Study Region

Name	Max. Recorded Flow (l/s)	Comments
Zarbi	31	
Nimra	93	Fed from Hummar formation and utilised for irrigation. Flows may now be negligible but are running.
Husayya	13	
Sukhna	232	Fed from Hummar formation and utilised for irrigation. Has in the past been a major supply source for Ain Sukhna village but now utilised only for irrigation. No longer believed flowing.
Zarqa	423	Fed from the Upper Aquifer and historically was a major source for the old Zarqa town. Now effectively dry and disused.
Ras El Ain	195	The original source of water for Amman. No longer utilised.
Russeifa Spring	n/a	

Note: Only Nimra springs are located on Figure 4.14
Source: Bender 1988.

Other springs identified from the available mapping are also located on Figure 4.14. These are typically utilised by local populations as required though in most cases no longer for potable supply.

4.7 GROUNDWATER RESOURCES

4.7.1 Hydrogeology

The geological succession in the region may be hydrogeologically subdivided into stratigraphical units that form aquifer and aquiclude systems as indicated in Tables 4.11 and 4.12. Four principal aquifers shown in Figure 4.16 underlie the study region, namely:

- Shallow aquifer
- Upper aquifer
- Lower aquifer
- Deep aquifer

LEGEND

PROJECT CORRIDOR

PROPOSED GROUNDWATER PROTECTION AREA (1977)

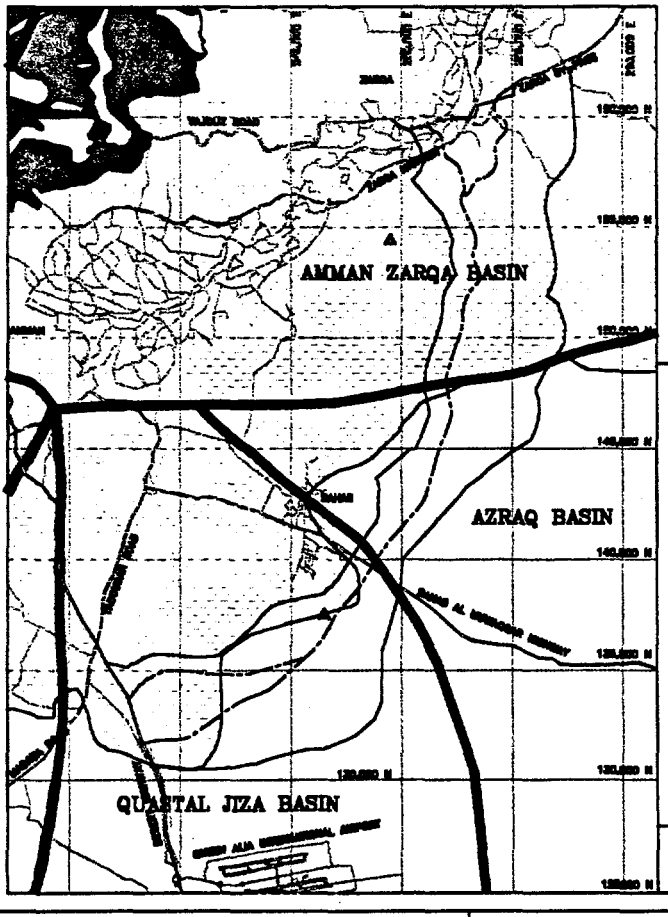
TOTAL DISSOLVED SOLIDS

< 500 ppm

500 – 1000 ppm

> 1000 ppm

FIGURE 4.16
GROUNDWATER QUALITY (1977)



LEGEND

PROJECT CORRIDOR

GROUNDWATER DIVIDE

SHALLOW AQUIFER POTENTIAL RECHARGE AREA

DEEP AQUIFER POTENTIAL RECHARGE AREA

LIMESTONE AQUIFER RECHARGE AREA

WASTE DISPOSAL SITE

FIGURE 4.17
AQUIFER RECHARGE ZONE

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AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT

Table 4.11 Aquifer Hydraulic Complexes and Aquicludes

Era	Period	Epoch	Aquifer System		Ref.	
Cenozoic	Quaternary	Holocene	Fluviatile, lacustrine and aeolian mantle rocks		R	Shallow
		Pleistocene		Jafr Azraq	Ja Az	
			Volcanics	Basalts	V	
	Tertiary	Pliocene		Sirhan Dana	Si Da	
		Miocene	Volcanics	Basalts	Ba	
		Oligocene	Belqa	Wadi Shallala	B5	
		Eocene		Rijam	B4	
		Paleocene		Muwaqqar	B3	
Mesozoic	Upper Cretaceous	Maestrichtian		Amman	B2	Upper
		Campanian		W. Ghudran	B1	
		Santonian	Ajlun	Wadi Sir	A7	
		Turonian		Shueib	A5-6	
		Cenomanian		Hummar	A4	Lower
				Fuheis	A3	
				Naur	A1-A2	
	Lower Cretaceous	Albian	Kurnub	Subeihi	K2	Deep
		Aptian		Arda'a	K1	
	Jurassic	Neocomian	Zerqa	Azab	S2	
	Triassic			Main	S1	

Aquiclude

Source: After Bender, 1988

4.7.2 Groundwater Quality

At the time of the 1977 National Water Master Plan the natural quality of the groundwaters in the region was fair to good and reasonably consistent with TDS levels generally in the range of 400 - 750, occasionally to 1000 ppm, as indicated on Figure 4.17 and Table 4.13.

Table 4.13 Groundwater Quality Criteria, National Water Master Plan

Salinity		Use Suitability			
			Irrigation		
TDS ppm	Micromhos	Water supply	salinity hazard	sodium hazard	Stock watering
< 500	< 750	Good	Medium	Low	Good
500 - 1000	750 - 1000	Fair	High	Low	Good to medium
> 1000	> 1500	Medium to poor	High to very high	Low to high	Medium to poor

Source: National Water Master Plan, 1977

However since that time there has been a marked deterioration in water quality, especially in the Zarqa Region where as Table 4.21 indicates TDS levels are generally well over 1500 mmhos often reaching levels in excess of 3000. This deterioration is generally attributed to localised over extraction which has resulted in a lowering of the aquifer and increased salinity levels.

Table 4.12 Hydrogeological Characteristics of Geological Series

Alluvial and other Recent Aquifers (part of Shallow Aquifer) Sedimentary rocks and alluvial deposits, primarily wadi fills
Volcanics (part of Shallow Aquifer) The basalts from Jebel Druze to Azraq and Wadi Dhuleil form an important regional aquifer. High quality groundwater that does not generally discharge directly from the basalt areas but flow from a groundwater mound to a contact zone to other aquifers (limestone and gravel) discharging as springs and base flow. Therefore the water bearing sediments of Tertiary and Quaternary Age are considered one aquifer system. Only discharges relevant to study area is 23 MCM p.a. to Wadi Zarqa (Upper Aquifer).
Rijam Formation Acts as shallow aquifer and is the main source of water in Azraq, Wadi Sirhan and Jafr Basins. Jointed bands of chalk, and chert with chalky marl bands. Joints contain solution channels. Recharge to aquifer originates from the Basalt Aquifer in the northern Azraq Basin. Flows are to springs at the centre of the basin (14MCM). Coefficient of permeability from 0.15 to 6.0 m/d. Transmissivity ranges from 6m2/d to 230 m2/d. TDS from 230 to 1500 although increasingly saline with waters from Wadi Sirhan and Shallalah.
Muwaqqar Formation Regional Aquitard comprising a thick sequence of chalk and marls from 70 -300+m thick
Wadi Ghudran with Wadi Es Sir (Upper Aquifer) Combine to make the most important aquifer system in the country. Wadi Es Sir light grey thinly bedded limestones with chert bands and nodules of 80 - 200m thickness. Wadi Ghudran correspond to the Silicified limestone and overlying Phosphorites. Exposed in highlands where receives direct recharge and indirect recharge (via drainage). Also receives transfer from Basalt aquifer in Wadi Dhuleil area Recharge 170 MCM direct; indirect, 143 MCM, transfer 23 MCM. Movement is controlled by the regional dip of strata in general to the east. Deeply incised wadis form major groundwater discharge foci flowing west to the rift. Five structural fractures also affect flow though none within the study area. Water quality TDS is highly variable from 300 - 1850 ppm better with depth.
Shueib Formation Aquitard of massive crystalline limestone with marl intercalations (33m - 127m thick)
Hummar Formation (Lower Aquifer) This is an important aquifer supply to the Amman-Zarqa syncline. Elsewhere its productivity is limited. Aquifer is about 45m thick and confined between the Fuheis and the overlying Shueib Formation. The formation is also a major contributor to the Salt syncline (from Baqa'a - Sukhna). Total estimated recharge is 5 m3m. The recharge area is limited to about 20km2 extending from Sukhna and around the edges of the Amman - Zarqa syncline (Wadi Es Sir, Bayadir etc.). Mean coefficient of permeability is 0.8 - 65 (elsewhere much lower). Artesian pressure in syncline sufficient to sustain wells. Water Quality good with TDS 230 - 770.
Fuheis Formation Aquitard: This an olive green marl intercalated with marly-limestone 70 - 80m thick.
Naur Formation Limited recharge and low permeability restrict use to local supply. Lower parts comprise marls that form aquitard with lower Kurnub Upper part is thick limestone layers (30 to 40m) confined by interspersed with marls that form confining layers. Layer overlain by Fuheis marls that act as the confining layer. Recharge is confined to the exposed area (4.5 MCM per annum) and is rejected as spring flow. Transmissivity is 3 - 6m2 day and well yields 10 -15 m3 per hr. Water fresh TDS400 ppm.
Kurnub Group (Deep Sandstone Hydraulic Complex) Kurnub and underlying Zerqa group have similar hydrogeological properties and together form a single regional aquifer. Exploited in the Upper Zarqa Basin. Recharge is limited to its small outcrop area and to leakage from overlying carbonate aquifers.

Contamination from the Amman - Zarqa connurbation is also a major problem. This was also recognised in the NWMP which recommended the establishment of groundwater protection areas in which waste disposal would be prohibited and restrictions applied to particular activities for the areas shown on Figure 4.17.

Table 4.14 Groundwater Quality in the Zarqa Region, 1990s

		Wadi Dhuleil		Refinery		Power Station	
	Zarqa 1992	<1985	>1985	1993	1971	1993	1977
EC *us*/cm	1700	1706	3359	3300	460	2300	600
pH value	7.2	7.5	7.3				
Ca meq/l	5.5	6.0	11.1				
Mg meq/l	3.9	4.6	10.0				
Na meq/l	7.5	6.7	14.1				
K meq/l	0.15	0.16	0.21				
HCO_3 meq/l	4.3	3.5	3.0				
SO_4 meq/l	2.2	4.6	7.3				
CL meq/l	9.6	9.2	21.8				
Br mg/l	3.3		8.5				
TOC mg/l	4.8		7.8				
COD mg/l	2.4		16.1				

Source: Water Master Plan, National Industrial Pollution Study, NES

4.7.3 Recharge

The principal recharge areas in the study area are shown on Figure 4.16. Three factors are of note:

- The industrial areas near Zarqa lie over the main recharge area.
- The areas of greatest agricultural activity and therefore pesticide and chemical use also overlie the recharge areas.
- The concerns expressed in documentation reviewed to date suggest that urban expansion is at this time viewed primarily as a 'contamination' threat to groundwaters. Clearly these concerns are valid and will be exacerbated if the project acts as a catalyst to a new phase of urban area expansion for Amman. In the longer term however, the potential impact of continued urban expansion on the volume of recharge may be viewed as equally significant as hard stand areas, and run off coefficients in general, continue to increase within the natural recharge zones.

4.7.4 Resource Significance and Use

The overall significance of these resources is put into context within the framework of the National water balance shown in Table 4.15.

At the local level there are number of groundwater user groups and use patterns that will need to be considered in project planning.

- Private wells: Private wells proliferate in the study area but unlike many countries in the region, these are generally well recorded and licensed. However of the 12 sites listed on WAJ records (Appendix G) defined as within a 600m corridor of the proposed centreline only two could be found. In this context it is important to note the following:

Table 4.15 Jordan National Water Balance (MCM per annum)

			1990	2000	2010	2020	2030
Demand	M and I	Municipal	240	340	477	870	1263
		Industrial	43	78	110	130	170
	Irrigation	Jordan Valley	300	350	350	350	350
		Southern Ghors	40	40	75	75	75
		Wadi Araba	4	4	13	13	13
		Highlands	289	289	289	289	289
		Disi	59	59	59	59	59
	Total Demand		**975**	**1160**	**1373**	**1586**	**2219**
Available Resources	Treaty Allocations		130	140	155	155	155
	JRV Wadis		120	153	175	175	175
	Groundwater	**Northern Aquifers**	**460**	**410**	**264**	**264**	**264**
		Wadi Araba	4	4	13	13	13
		Disi	12	15	120	170	170
	Wastewater Re-Use	% Municipal Demand	20	25	30	35	50
		Total re-use	48	85	143	234	631
	Total Resources		**774**	**857**	**968**	**1148**	**1573**
	Shortfall		***201***	***273***	***407***	***439***	***645***

Source: JRV Master Plan

- there is little or no evidence of the use of private wells for agricultural activity outside of the main Desert Highway corridor
- There is apparently negligible use of wells in the rangeland areas to water herds. In all observed cases during field studies water supplies were provided by tanker. Similarly, no watering site (drinking troughs) linked to a well was identified.

- Major public wells are located in the Qastal area near the Desert Highway. These are sealed boreholes typical of those developed for public use. Well depths are relatively shallow, generally of the order of 200m below ground level.

4.8 AIR QUALITY

There are three basic sources of potential air pollution:

Stationary Sources: Principally the major point sources as indicated in Table 4.16.

Mobile Sources: It is estimated that there are some 297 000 vehicles of all kinds in Jordan of which some 70% are registered in Amman and Zarqa. These generate the emission of the following pollutants: Pb, NOx, CO, CO_2, SO_2 and the photochemical reactions

The Jordan Petroleum Refinery has commenced producing unleaded petrol and is studying desulfurization of fuel. Jordan must encourage introducing non leaded petrol gradually trying to attain in the next ten to fifteen years standards that are a available in Europe today.

An arrangement to improve air quality that allows taxi drivers to replace their old vehicles (fifteen years and older) tax free is also now in place.

Table 4.16 Major Point Sources

Site / Types of Activity	Pollutants	Comments
Petroleum Refinery Zarqa	CO, CO_2, H_2S, SO_2 and Hydrocarbons	To the north of Zarqa some 8 kms from the Project
Al-Hussein Thermal Power Plant	CO, CO_2, H_2S, SO_2 and NOx	To the north of Zarqa some 8 kms from the Project
Phosphate Mines	Dust (non operational)	Russeifa Site that lies adjacent to Zarqa Highway was a source of major concern. Even now the bare spoil heaps are a source of dust.
Industrial Estates	Cl_2, F_2, Pb, SO_2, CO	Industrial Estates in E. Amman, Russeifa, Zarqa and Sahab all lie in relatively close proximity to the alignment.
Individual Plants	Activity Specific	
Quarries and Asphalt Mixing	Dust, CO, CO_2, SiO_2,	Major quarries lie adjacent the corridor especially in the vicinity of Wadi Ush.
Solid waste burns	CO, CO_2	Sahab waste tip

Natural Sources: The most significant of these would be the sand and dust storms associated with the strong winter depressions.

There are no known valid assessments of air quality at a regional level though the findings of the JEPSB report of 1989 may remain valid. That is, Jordan is still fortunate to have a clean air environment, with the absence of health hazards (air quality related) being primarily a function of the limited extent of industrial development.

While this generalised statement may still hold true at the regional level, by the time of the publication of the NES in 1991, the findings of a number of studies had become available and the situation viewed more critically. The results of two studies[4] in particular are of relevance to the project as indicated in Table 4.17.

[4] Additional data is being obtained from the RSS and GCEP on ongoing programmes but these were not available for this submission.

Table 4.17 Summary of Findings of Recent Air Quality Studies

Study	Findings
Air Pollution Monitoring in Amman: 1986-90	Levels of TSP in downtown Amman. exceeded most international health guidelines Downtown annual mean SO_2 levels exceed permissible international guidelines though the daily mean was generally acceptable CO levels exceed WHO standards for approximately 25% of the year. During 1989 conditions in downtown Amman were sufficient to cause a Photochemical smog
Hydrogen Sulphide Pollution in Populated Areas of Hashemiya Township, (1989)	Levels of H_2S are exceeded international standards especially during the night and in winter. Impact of other pollutants from Power Station and Refinery not evaluated.

Source: NES, 1993 RSS, 1996

In addition to the concerns in downtown Amman the Traffic study also concluded that there is a need for greater monitoring of pollution levels in Awajan and Zarqa
In summary the NES concluded that the 'Main Issues According to Priority' in this context are as follows[5]:

1. Zarqa Basin: including:

- Hashimiya: Three major sources, JPR, HTPS, and the KSWTP generate SO_2, H_2S, CO Hydrocarbons, TSP and NOx.
- Zarqa Urban Area: Affected primarily by pollution from urban and peri urban industrial facilities, and traffic..
- Russeifa Phosphate dusts: (Production has since been discontinued)

2. Downtown Amman: Traffic pollution exacerbated by topography which prevents dispersion of pollutants. High levels of TSP, SO_2, CO and NOx are experienced.
3. Natural Dust storms

These are reflected graphically on Figure 4.18.

Overall therefore, while air quality in the urban centers in Jordan is largely acceptable, initial monitoring of pollutants has begun, involving measurement of SO2, NOx, TSP, CO, and PB, in Amman, and Zarqa in response to increasing concerns.

4.9 NOISE

A review of relevant literature available in Jordan would suggest that noise is not viewed as a significant (environmental) issue. Moreover, this conclusion may be supported by the decision of the participants and committees of the NEAP not to address the issue and further reinforced by the absence of available ambient measurements.

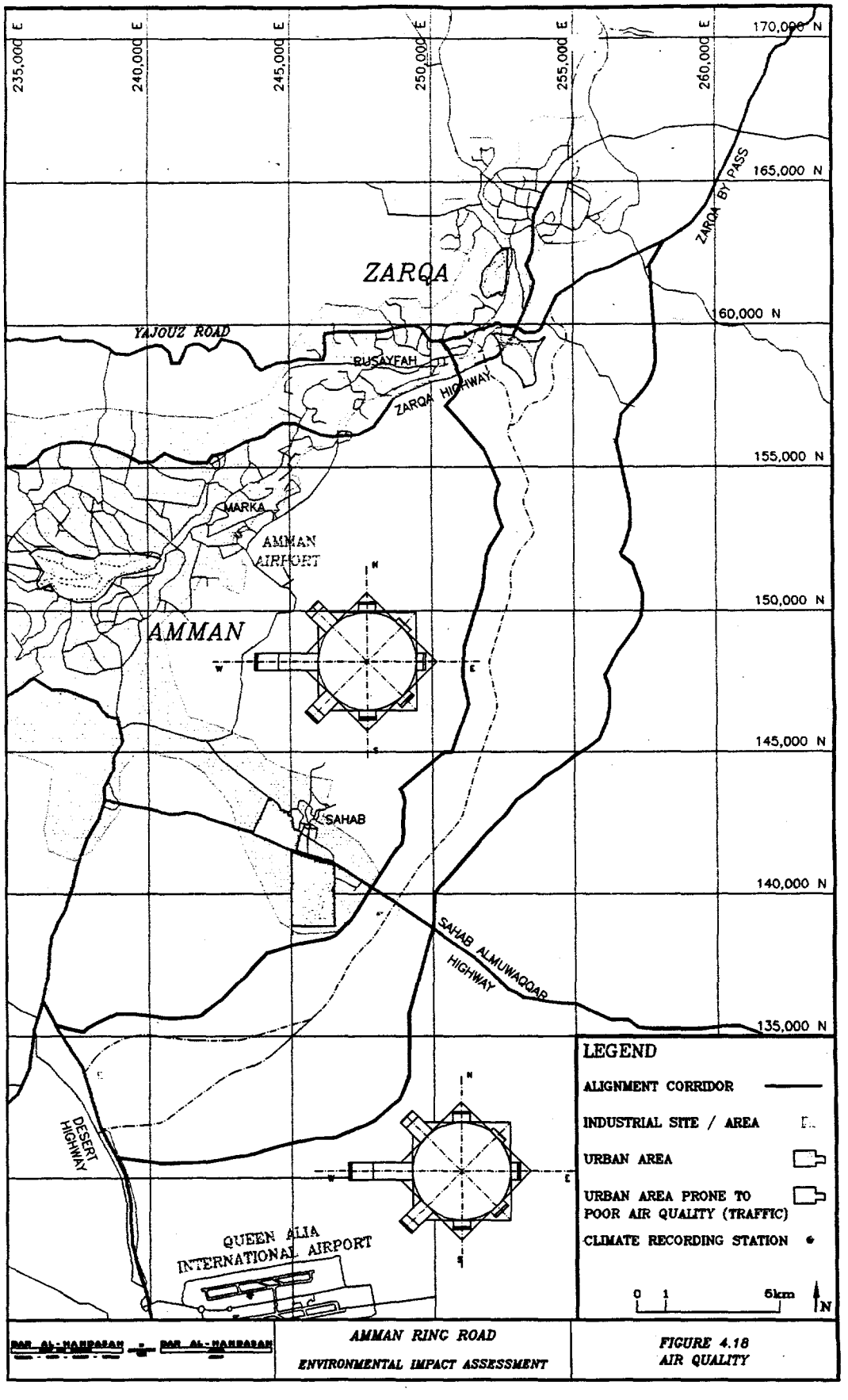
Whether this view is supported by the findings of the Project scoping exercise or not is open to some question.

[5] Text is paraphrased from the NES

The potential negative impacts of the project were noted only as of minor significance at one session, (Table 4.18), implying only very limited concern of noise related impacts.

Conversely, however, the provision of noise relief to existing urban areas was seen as a positive project impact of the highest significance at the Zarqa Session, therefore implying at least seem concern over present (or potential future) noise levels.

As noted above no coherent noise monitoring programme is yet in place and therefore no urban or network wide baseline can be established.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ZARQA
ZARQA BY PASS
YAJOUZ ROAD
RUSAYFAH
ZARQA HIGHWAY
MARKA
AMMAN AIRPORT
AMMAN
SAHAB
SAHAB ALMUWAQQAR HIGHWAY
DESERT HIGHWAY
QUEEN ALIA INTERNATIONAL AIRPORT
LEGEND
ALIGNMENT CORRIDOR
INDUSTRIAL SITE / AREA
URBAN AREA
URBAN AREA PRONE TO POOR AIR QUALITY (TRAFFIC)
CLIMATE RECORDING STATION
0 1 5km
N
DAIR AL-HANBARAH
DAIR AL-HANBARAH
AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT
FIGURE 4.18
AIR QUALITY

Table 4.18 Issues Classed as Highest Significance in all Sessions

	Significance					
Impact	5	4	3	2	1	Remarks
Reduce traffic jams	ZAF					
Inadequate land compensation	ZFA				Z*	*Tribal lands
Loss of forest	A(w) ZF		A(e)			
Impact on natural ground cover	FZ*	Z	A			*Beirain, Shafar and Badra areas specified
Air +	ZF	A				May reduce city pollution during operation
Improve Regional / local Transport	FZ	A				
Loss of agricultural land	ZF		A			Western part
Change in land use	AF		Z			
Damage / destruction / displacement of archaeological sites	AF			Z		Conduct survey
Stimulate econ gwth esp. in Tourism	FZ					
Improve National Transport	ZF					
Serve existing economic sectors	FA*	A				*Sector specific
Increase land value	AZ					
Landslides	F	Z(w) A*			Z(e)	* Urban Issue associated with floods
Impact on wildlife	F	Z	A			
Surface Water	F	A(w)		A(e)	Z	
Visual impact	A	F		A*	Z(e)	Visual Use Amenity
Provide access to archaeology / tourist etc.	F	A		Z		
Division of communities/ Impact on social patterns	F	A		Z		
Land division	A**		AF		A*Z	* in a Planning Context ** in Urban issues context
Groundwater	F		Z(+)	AZ(-)		
Damage / access restriction to cemeteries	A				ZF	
Increase demand for groundwater	F	A				
Pedestrian Safety esp. schools	Z	F				
Noise +	Z	A		A*		in existing cities * negative in new areas
Urban expansion onto agricultural lands	Z		F			
Loss of rangeland	Z		A			
Soil erosion	F		Z			Significance varies by area
Obstruction of access	F		A			
Disruption of community activity pattern/social structure	Z				A	May be significant in some areas

Positive Impact

4.10 ARCHAEOLOGY

As Table 4.19 indicates archaeological sites in Jordan reveal a human presence going back to the Palaeolithic Period or some 100,000 years ago.

Table 4.19 Major Archaeological Periods and Sites

Period		Major Sites	Years
Palaeolithic	Azraq		100000 - 14000
Mesolithic	Beidha Ain Ghazal		14000 - 8000
Neolithic	Beidha Ghannam Ghrubba	Sha'ar ha Golan Tell Abu Habil Tell Esh Shuna	8000 - 4500
Chalcolithic	Ghassul Sahab		4500 - 3300
Bronze Age	Early -late		3300 - 1200
Iron Age	Early -late		1200 - 539
Persian			539 - 332
Hellenistic			332 - 63
Nabataen		Petra	350 - 106
Roman		Jerash, Pella, Philadelphia and Umm Queis	63 - 234
Byzantine		Madaba, Um El Jamal	324 - 524
Early Islamic			624 - 1099
Crusader and Arabic			1091 - 1291
Mamluk			1291 - 1516
Ottoman			1516 - 1918

Source: EA Jordan Valley Irrigation Project, 1980

Figure 4.19A locates the sites listed on the Jordan Antiquities Database and Information System (JADIS) and identified that may be affected by the project[6]. The apparent relative concentration of sites in the vicinity of Umm Al Basateen - Naur area is however to some extent misleading, reflecting the density of survey work and study carried out to date more than the probable real distribution of sites.

This view point is reinforced by the relative number and density of sites that are defined in the detailed surveys undertaken for the Eastern Sections of the road[7].

After further review of all the sites the MOTA have (for the purposes of this study only) categorised them as shown in Table 4.20.

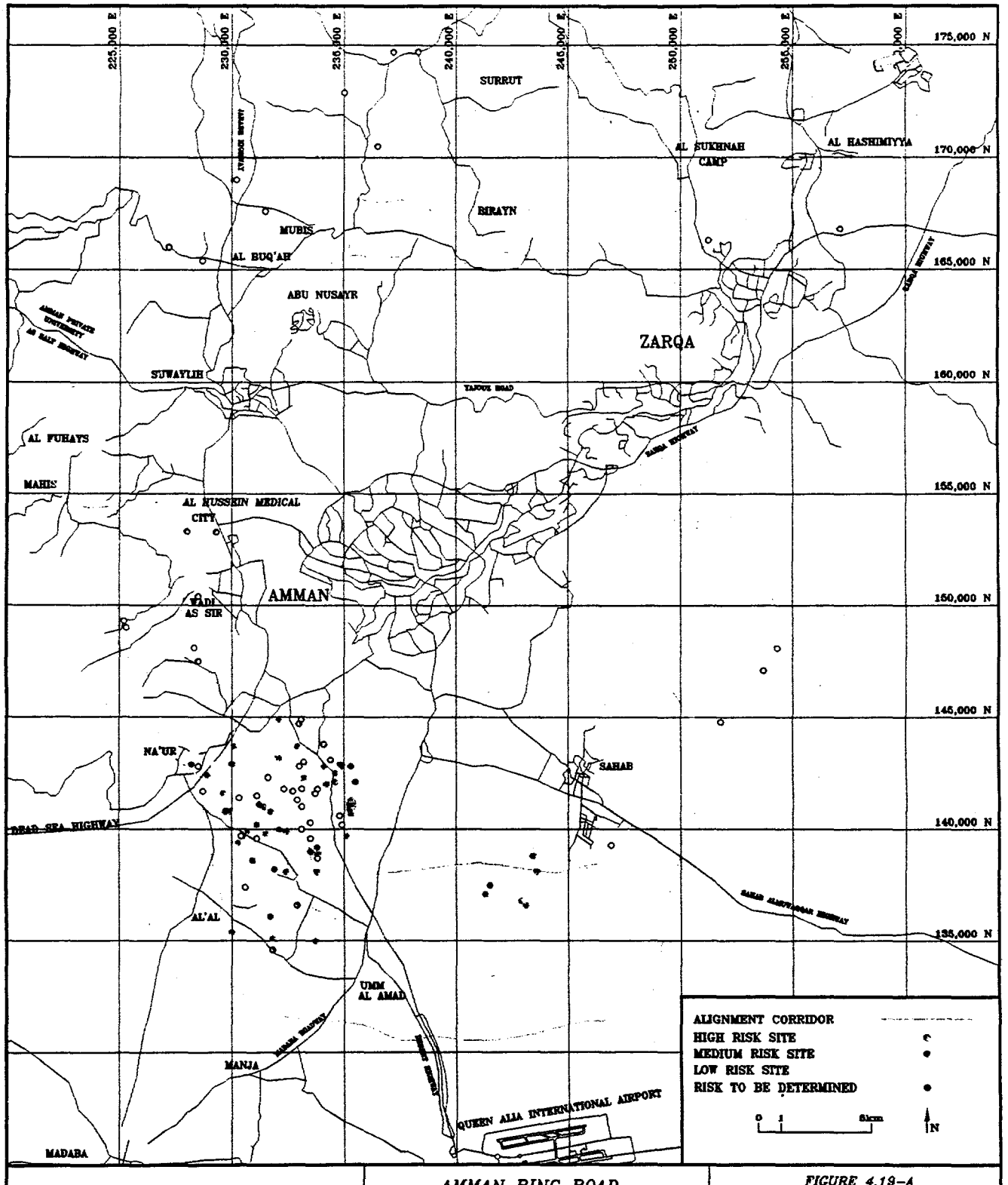
Table 4.20 Archaeological Sites in the Corridor

Category of Significance	Number of Sites	Comments
High Risk		
Medium Risk		
Low Risk		
Total		**1 undefined**

Source: MOTA Project Survey and JADIS

[6] These are reported on in Volume 3: Preliminary Cultural Resources Impact Assessment.

[7] At this time in excess of 30 sites have been defined.

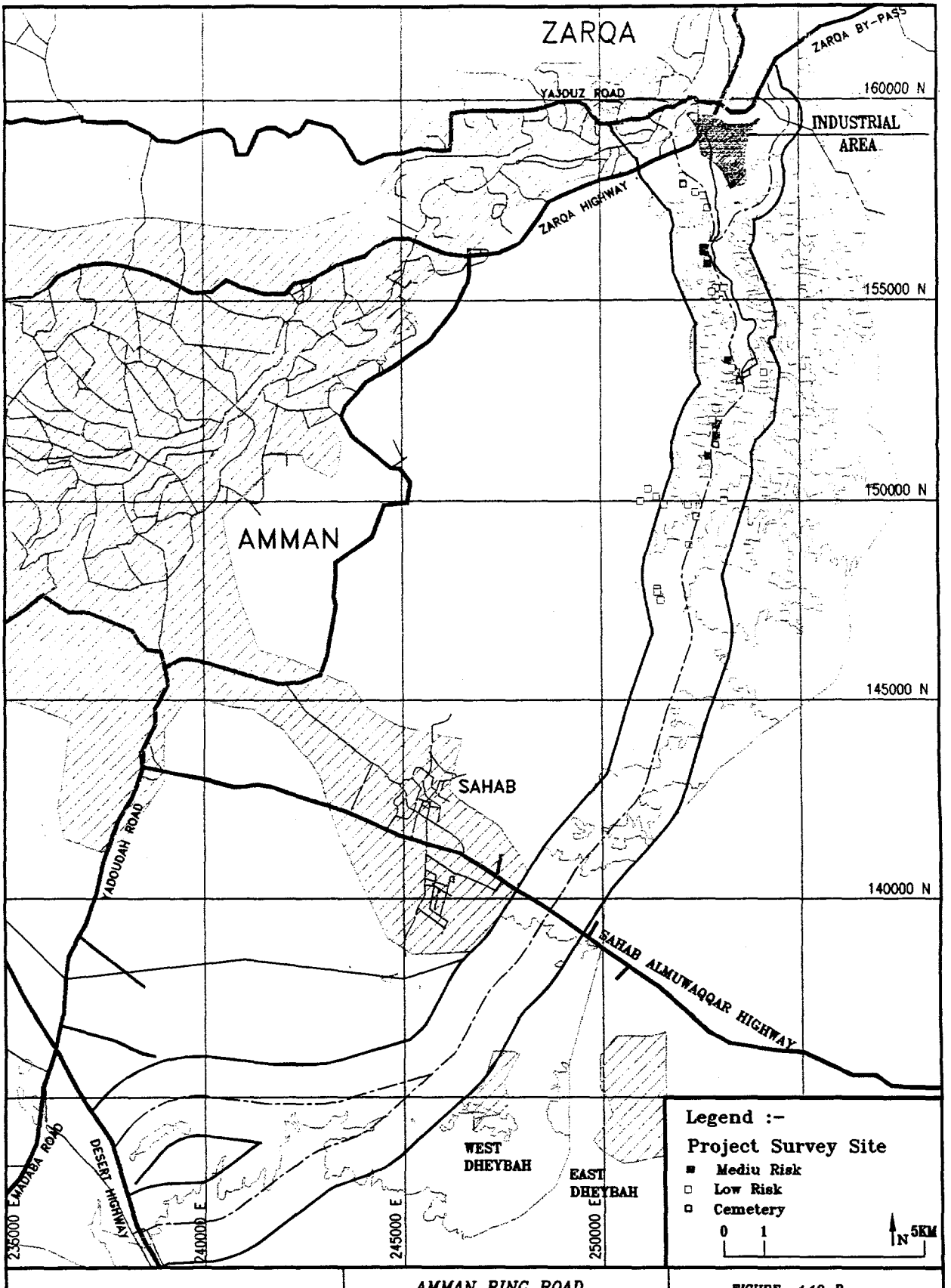


AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 4.19-A

CULTURAL AND HISTORICAL SITES ON JADIS



DAR AL-HANDASAH — DAR AL-HANDASAH

AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 4.19-B

CULTURAL AND HISTORICAL SITES DEFINED IN PROJECT SURVEY

4.11 DATA WEAKNESSES

The data collection and review process for this EA has been extensive, and has covered a wide range of institutions and reference works. In the context of this section on the Physical Resource Base there are two, interrelated areas of significant data weakness.

- Absence of data on ambient noise levels.
- Absence of data on ambient air quality.

There are no ongoing monitoring programmes established to provide baseline data for key (or vulnerable) areas. Available data is confined to that collected for project specific purposes and provides no basis for assessment of ambient levels. Predicted levels can therefore only be compared to predicted estimates of existing conditions that are not calibrated to measured values.

In a related context little or no research has been carried out in to the health effects of air quality in Amman and Zarqa outside of that carried out in relation to the Phosphate company at Fuheis to the west of Amman..

Two other areas of data weakness should also be noted:

- Flora and fauna; No project specific surveys yet undertaken. The assessment provided is based on reconnaissance visits and desk research.
- Hydrology: Given that all water courses in the Project Area are seasonal it is unsurprising that there is no available data on flows and water quality. While such values may be readily calculated using established guidelines and formulae there are always concerns when such estimates can not be related to time series data.

SECTION 5:

SOCIO ECONOMIC CONTEXT

SECTION 5: SOCIO ECONOMIC CONTEXT

5.1 INTRODUCTION

This Section comprises a further seven sub sections that provide a socio economic context for the Project. In Section 5.2 the population that may be affected by the project, now and in the future, is assessed and its characteristics defined.

Section 5.3 outlines the broad pattern of economic activity in the Study Area, identifying significant past trends and commenting on future prospects at the sector level. Where appropriate in this review attention is drawn to specific linkages between sectoral activity and the Project.

In Section 5.4, the transportation and access and utilities networks of the Study area are briefly described and Sections 5.5 and 5.6 deal with issues related to urban development. Each of the factors reviewed in Section 5.2 to 5.6 is drawn together in the penultimate, Section 5.7 which a provides summary of social indicators for Study Region.

5.2 POPULATION

5.2.1 National and Regional

The most recent data on population is from the 1994 census which estimates the National population at 4,139,458 - up from 2,133,000 in 1979, the date of the preceding census. This represents an average annual rate of increase of around 4.35%. However, these statistics shown in Table 5.1 are influenced by the Gulf crisis which prompted the return of around 300,000 people in 1990/1991, when the annual rate of increase was 5.3%.

Table 5.1 Historical National Population Growth: (1952-1994)

Year of Census	Population	Ann. Pop. Growth Rate %	Ann. Natural Rate of Increase: (%)	Annual Net Migration Rate: (%)
1952	586,085	-	-	-
1961	900,776	4.8	2.8	2.0
1979	2,132,997	4.3	3.3	1.5
1994	4,139,458	3.6	2.6	1.0

Source: Dept. of Statistics, 1996

National populations are strongly urbanised with urban areas accounting for some 77% of the total. Regionally growth is similarly distorted, with the fastest growth occurring in the Middle Region, which also accommodates some 64 % of the total National population.

5.2.2 Study Area

The Governorates of the Project Study Area, Amman, Zarqa and Madaba, have relatively high population densities[1], ranging from 120 to 248 persons per square kilometer. As the data in

[1] When compared to a national average of 46 persons per km^2

Table 5.2 indicates annual growth rates are variable, being around the National average[2] in Amman and Zarqa, 3.6% and much lower in Madaba (1.6 %).

Table 5.2 Distribution of Population by Statistical Divisions, 1994 and 1996

Governorate and District	1994	1996
Amman Governorate	**1,576,238**	**1,696,300**
· Amman Sub-District	1,307,017	1406572
· Sahab	49,060	52797
· A Muwaqqar	18,239	19628
Jiza	32,446	34917
· Naur	28,986	31194
· Um Al Basateen	8,313	8946
Zarqa Sub-district	**639,469**	**687,000**
· Zarqa	622,570	668,845
· Al Azraq	9,193	9,876
· Beirain	7,706	8,279
Madaba Governorate	**107,321**	**110,700**
Madaba Sub-District	83,824	86,463
TOTAL	**2,599,110**	**2,771,063**

Source: General Census of Population and Housing of Jordan, 1994; Statistical Yearbook 1996; Department of Statistics

The population of Madaba Governorate is unlikely to be directly affected by the project but may be subject to significant indirect impacts, both positive and negative.

5.2.3 Directly Affected Populations

The populations that may be directly affected by the project are considered to be confined to those areas listed in Table 5.3. The total population of the defined Governorates is estimated at 2.8 million. That for the affected region around 2.1 million, of which 1.4 million reside in Amman and that for local, directly influenced populations,

5.2.4 Population Forecasts

According to the Department of Statistics the current rate of growth of population at the National level is 3.6%. For the national base case, it is proposed to use this rate of growth to 2005. It is anticipated that National natural growth rates will decline over this period and therefore the retention of this value for the project area reflects an assumed rate of in migration related to the Region's preeminence in the National economy. Beyond 2005, growth rates are projected to drop in line with the expected declines in natural growth that generally accompany economic and social development. Table 5.4 summarises the growth rates used in population projections to the year 2030.

Applied to the estimated current populations of the Governorates these growth rates give the projected populations presented in Table 5.5. These indicate an increase of some 2.5 million people between 2000 and 2020 with a virtual doubling by 2030 to 7.4 million.

[2] The National growth rate itself is high at 3.6 % and the close relationship between the Amman and Zarqa figures and the National rate is probably a reflection of the dominant influence of the Amman-Zarqa urban area on national population statistics.

Table 5.3 Estimated Current Population in the Direct Zone of Influence of the ARR

LOCATION	ESTIMATED POPULATION
Population Centres Affected by Alignment	
1. Khashafiat al Dabaiba	2,524
2. Al Abdalia	3,159
3. Al Faisalia	3,186
Sahab	32,147
4. Rajm al Shami al Gharbi	2,676
5. Rajm al Shami al Sharqi	370
6. Al Laban	1,272
7. Al Tnaib	90
8. Al Qastal	1,964
Total	**47,388**
Other Regional Centres in Vicinity of the ARR	
Al Bassa	2,833
Um al Basateen	3,382
Um al Amad	1,207
Al Zetona	308
Al Samek	1,471
Al Alal	1,987
Naour	12,355
Marj al Hamam	16,592
Iraq al Ameer	1,488
Qura Bani Hashem	3,399
Al Sokna	9,985
Al Hashmia	19,177
Kerbat al Samra	1,886
Total	**76,071**
Amman	1,404,796
Zarqa	352,972
Russeifa	215,294
Total	**1,973,062**
GRAND TOTAL	**2,096,520**

Source : Middle Region Planning Authority

Table 5.4 Population Growth Rates by Scenario; (AGR %)

	SCENARIO		
Period	**Low**	**Base Case**	**High**
1997- 2005	3.0	3.5	3.5
2005-2010	2.75	3.0	3.5
2010 -2020	2.5	2.75	3.0
Beyond 2020	2.25	2.5[3]	2.75

Source: Consultants Estimates

Table 5.5 Population Projections for the Study Area (000s)

Region	1994	1996	2000	2005	2010	2020	2030
Amman Governorate	1576	1696	1947	2312	2680	3515	4500
Zarqa Sub-district	639	687	788	936	1085	1424	1,822
Madaba Governorate	107	111	127	151	175	229	294
TOTAL							

Source: Consultants Estimates

[3] Jordan Valley, Sanitation Study, 1996 assumes long term rates of growth of 2.6%

The base case rates used in this calculation are a little higher than those forecast by the Middle Region Planning Authority which has forecast future population growth over the period at rates between 2.9% p.a. and 3.3% p.a. according to its low and high growth scenarios.

In either case it can be seen that the anticipated increases will place considerable strain on the identified land, and other, resources available within Greater Amman and its surrounding areas.

5.2.5 Forecast Population Distribution and Urban Growth

The future distribution of the projected population will vary depending on a range of factors, not least, government policy, rates of land release and approval of developments and interrelated factors such as land prices as well as exogenous factors, most notably, political stability at the Regional Level and economic integration.

Historically, as noted earlier and shown in Table 5.6, growth rates in the study area have been quite variable, with Amman Municipality growing at around 3.3%, considerably less than the 5 to 8 % typical of the developing areas on its periphery. It is also notable that the settlements to the west of Amman, i.e. Salt, Fuheis and Mahes have relatively lower growth rates, averaging between 4 and 5%

Table 5.6: Population Trends 1979 - 1997

Area	Population			Annual Growth Rate %	
	1979	1985	1997	1979-1985	1985-1997
Amman, Marka	623,000	720,000	1,058,650	2.1	3.3
Rest of Amman	117,400	188,800	492,400	7.0	8.3
Zarqa	216,000	257,500	380,300	2.5	3.3
Russeifa, Mushreifeh	85,000	97,200	231,100	1.9	7.5
Sahab	17,600	21,600	50,200	3.0	7.3
Naur, Marj el Hamam, Um el Basateen	10,200	22,200	39,700	11.7	5.0
Madaba	28,200	34,900	88,500	3.1	8.0
Jiza, Um Al Rasas	4,500	5,100	34,950	1.8	17.3

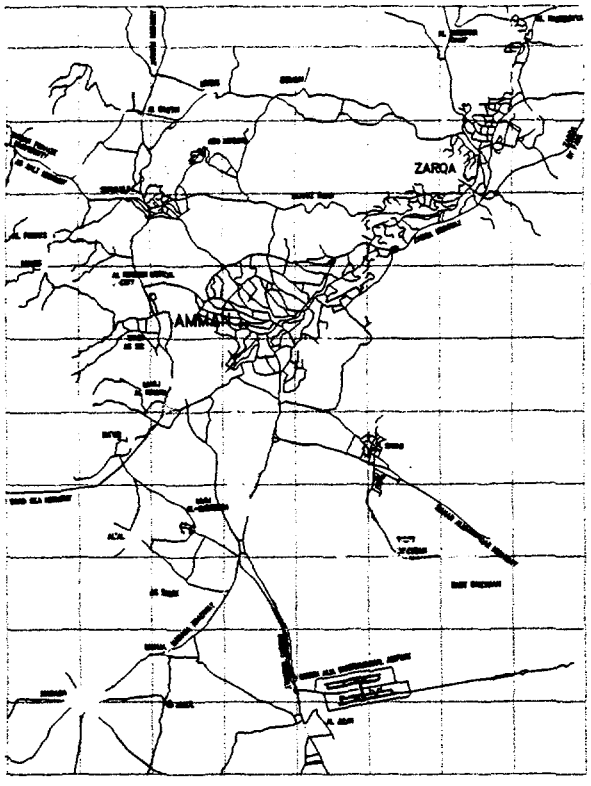
Source: Department of Statistics, 1994

With respect to future patterns of urban growth, the Consultants have found little if any data or analysis that would suggest that present trends (and the associated trends in activity patterns) will markedly skew or adjust in the short to medium term unless in response to specific government policy and related actions.

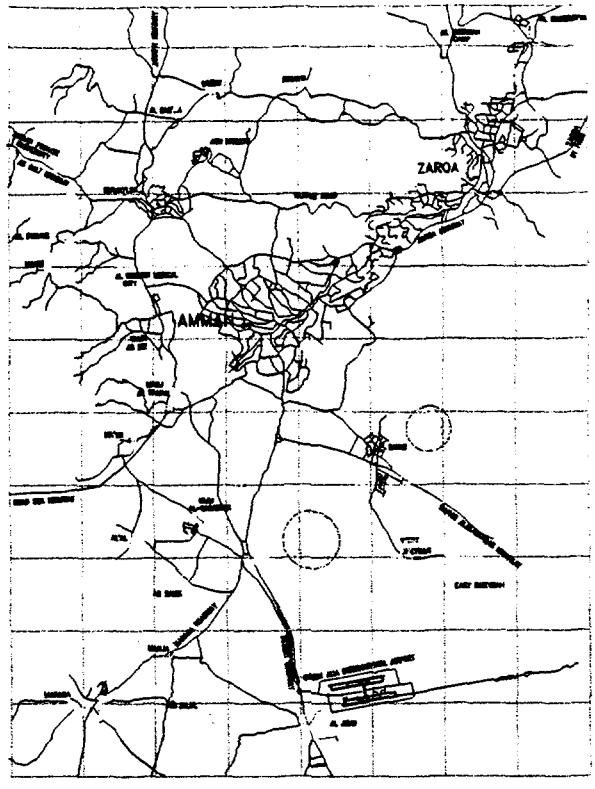
Similarly, there is little evidence of significant shifts in the direction of trend in the recent past, to the extent that the three basic scenarios developed for the Greater Amman Comprehensive Development Plan (GACDP) in 1985, (Figure 5.1) remain largely valid, today, i.e.

- **Scenario 1:** Allows for continued expansion of the urban areas along pre existing trends. Relatively weak planning control exercised leading to the extension of the urban area, mainly to the north-east and south;

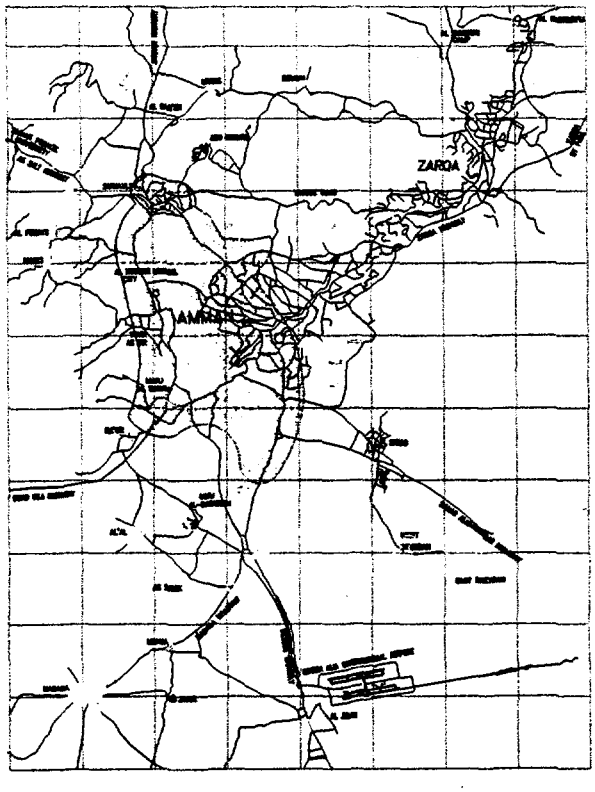
A : UNCONTROLLED EXPANSION



B : GROWTH POLES



C : INTENSIFICATION



LEGEND: –

EXPANSION

GROWTH POLE

INTENSIVE GROWTH

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AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 5.1

GACPT DEVELOPMENT OPTIONS

- **Scenario 2:** With relatively strong planning controls, the constraints and policies of the area and defined government policies would be recognised and adopted as planning guidelines. New urban developments (growth poles) would be concentrated in a series of satellite towns to the south-east of Amman, avoiding agricultural lands.
- **Scenario 3:** Applying a more flexible interpretation of the regional constraints and Government Policies and taking into account the current trends and development pressures by reinforcing key development centres.

However, while the trends inherent in these Scenarios may remain valid it should be noted that overall rates of growth in the intervening period have far exceeded those forecast. The population growth scenarios produced as part of the GACDP projected the population of the Amman and Baqa'a Regions to reach around 2.85 million in 2005, a forecast, which Table 5.7 shows, was actually reached in 1996.

Table 5.7: GACDP Population Forecasts

Area	Estimated 2005 Pop.	% Share	Annual Growth Rate %	Actual Estimate 1996
Greater Amman	1,687,000	59.4	3.2	1,696,300
Satellite Settlements	230,000	8.1	6.2	-
Zarqa	439,000	15.5	2.7	687,000
Russeifa/Musheirfeh, Shneller Camp	147,000	5.2	2.7	-
Madaba	69,000	2.4	3.5	110,700
Rest of Amman-Balqa Region	132,000	4.6	1.6	-
TOTAL		**100**	**3.1**	

Source: Consultants Estimates

5.2.6 Population Structure

Given the dominance of the Study Region on the National population, its structure is almost exactly mirrored by National Statistics as demonstrated by the data contained in Table 5.8. Overall the figures do not show a particularly skewed structure though there is a slightly surprising majority of men over women in the population as a whole, and in virtually all age groups.

Table 5.9 shows the National age sex distribution which highlights, that some 41% of the population are under the age of 15, with some 20% women of reproductive age and a further 6% in each of the future productive female cohorts. These figures are perhaps most significant when the population aged 6-15 are viewed as potential job seekers over the next decade.

Table 5.8 Regional Population Structure %

Governorate	Male	Female	Total
Madaba	52.21	47.79	100
Zarqa	52.01	47.99	100
Amman	52.27	47.73	100
Total	**1459900**	**1335400**	**2804300**
	52.06	47.62	100
National	**2319800**	**2124200**	**4444000**
	52.20	47.80	100

Source: Statistical Yearbook, 1997

Table 5.9 National Age - Sex Distribution %

Age Group	Total	Female	Male	Cumulative
0-4	14.90	7.26	7.64	14.90
6-10	13.68	6.68	7.00	28.58
11-14	12.78	6.23	6.55	41.36
15-19	11.68	5.61	6.07	53.04
20-24	10.95	5.07	5.88	63.99
25-29	9.16	4.10	5.06	73.15
30-34	6.58	3.06	3.52	79.73
35-39	4.56	2.18	2.38	84.29
40-44	3.41	1.64	1.77	87.70
45-49	3.07	1.55	1.52	90.77
50-54	2.76	1.28	1.48	93.53
55-59	2.22	1.05	1.17	95.75
60-64	1.65	0.80	0.85	97.40
65+	2.51	1.25	1.26	99.91
Unreported	0.09	0.04	0.05	100.00
Total	100	47.80	52.20	

Source: Statistical Yearbook, 1997

5.2.7 Household Structure

Household structures in the Study Region are shown in Table 5.10. The values in this Table present a largely predictable picture in which:

- Household sizes in Amman are less than those elsewhere, reflecting both the numbers of single men (migrants) and the relative higher income levels that might be expected to skew the data.

Table 5.10 Average Household Size

Governorate	No. of Hholds.	Population	Average Hhold. Size
Madaba	16183	106833	6.60
Zarqa	101186	635558	6.28
Amman	268688	1555915	5.79
Total Region	**428824**	**2570990**	**5.995**
National	**664878**	**4092397**	**6.155**

Source: General Census of Population and Housing 1994

- At the other end of the spectrum the predominantly rural Madaba Governorate has the largest household size, 6.60.

- The values for the Study Region as a whole have declined since 1985, when the GACDP reported an average household size of around 6.4 to 6.6. This is a relatively sharp decline in a decade, that even so, is perhaps understated given that the GACDP area excluded most of the larger size households in the rural areas.

The data in Table 5.11 indicates that there are surprisingly few multi household housing units, with the average, at 1.001 per housing unit showing almost negligible multiple use.

Table 5.11 Number of Households per Housing Unit %

	No. of Households			
Governorate	1	2	3+	Total
Madaba	99.87	0.13	0.02	100
Zarqa	99.77	0.21	0.05	100
Amman	99.87	0.12	0.02	100
Total	**99.83**	**0.15**	**0.02**	**100**
National	**99.83**	**0.15**	**0.02**	**100**
National Ave				**1.0018**

Source: General Census of Population and Housing 1994

The results of a small sample survey conducted for the Project Area in the Zarqa Region produced results that are broadly similar to those above. However, household sizes appear somewhat larger, with a consequent further shift in population structure to the younger cohorts.

5.3 REGIONAL ECONOMIC ACTIVITY

The proposed ARR will be affected by, and influence, economic activity and development within its vicinity as well as in areas further afield.

The Study Area broadly includes the "Middle Region" (Governorates of Amman, Balqa, Madaba and Zarqa) which accounts for about 80% of employment in the country. Annual increases in employment have varied considerably, but achieved an average of 7.6% between 1989 and 1994.[4]

Present levels of economic activity in this Region are shown in Table 5.12.

Table 5.12 Economic Activity in Middle Region

Governorate	No. of Enterprises	Employees	Value of Output (JD million)
Amman	6894	62420	1,223
Zarqa	1984	19981	912
Madaba	296	1792	28
Total Middle Region	**9855**	**91480**	**2,391**
Jordan	**13782**	**113122**	**3,066**
Middle Region: % of Jordan	71.5	80.9	78

Source : Middle Region Planning Authority

5.3.1 Industry

There is a major concentration of industry, particularly manufacturing, around Amman, which dominates the domestic market and export markets. According to the Industrial Census of 1994[5] nearly 70% (89,262) of all employees in the sector were employed, and 31 % (6,336) of

[4] Source: Middle Region Planning Authority

[5] Industrial Census, Ministry of Industry and Trade, Amman 1994

industrial enterprise were located, there. Summary data on Industries in the Middle Region is shown in Table 5.13.

Table 5.13 Industrial Sector Development in the Middle Region

Governorate	No. of Factories	Employees	Value of output (000 JD)
Amman	7123	66,181	1,408,247
Zarqa	321	14,368	195,142
Madaba	30	1863	19,034
Total	**7587**	**88,343**	**1,767,195**

Source : Ministry of Industry, Chambers of Commerce, Middle Region Planning Authority

A particular concentration is to be found at the Sahab Industrial Estate where 13,700 persons were employed in mid 1995, over 10% of total National employment in industry. This Estate imports 90% of its goods through Aqaba, and would therefore use sections of the ARR. It is also involved in trade movements with Iraq and Syria. In future it would be well placed to use Mediterranean ports if trade movements in the Region were liberalised. The ARR may also affect the Industrial Estate in terms of movements of its workers, 50% of whom commute from Amman, and a further 20% from Zarqa. Summary data on the Sahab Industrial Estate is provided in Table 5.14.

Table 5.14 Profile of the Sahab Industrial Area

Sector	No of Firms	Invested Capital (JD mill.)	Employees
Food Industries	37	104.8	1785
Pharmaceutical Industries	22	55.7	916
Engineering (Metallic and Electrical)	83	159.4	2967
Plastics and Rubber	49	51.4	1450
Chemical Industries	48	46.4	1268
Cotton and Weaving	38	85.8	1983
Furniture, Kitchen and doors	23	22.4	679
Printing, packaging and tissue paper	28	72.2	1835
Leather	10	3.5	100
Construction	10	12.5	345
TOTAL	**348**	**614.1**	**13,328**

Source : Sahab Industrial Estate, Jordan Industrial Estates Corporation, Oct. 1997

Outside of this estate, industrial activity in the study area is concentrated at a few other principal centres, namely, Zarqa, Marka, Hashemiya and the Hizam Road.

In addition there are a number of large individual units, both in the vicinity of the Ring Road and those further afield that are likely to use the road for access to sources of raw materials (for the most part imported through Aqaba), and for access to potential markets. Such sites would include, Jordan Refinery, Al Hussein Power Station and the Fuhais Cement Works.

5.3.2 Agriculture

Although at the national level, the Agriculture sector accounts for less than 10% of GDP, it is a key sector in the study region with direct and indirect impacts on the economy in terms of processing, transport linkages and as a generator of employment.

Large investments in the Jordan Valley resulted in increases in irrigated areas of 20%; major investments have also seen rapid increases in production in the Highlands. Between 1981 and

1991, irrigated area increased by 197 percent on the highlands to reach 362,000 ha. and by 20 percent in the Rift Valley, to some 337,000 ha. About two-thirds of the national vegetable production originates from the Jordan Valley, much of which is destined for Amman. In addition, the Jordan Valley accounts for 46% of the country's exports of vegetables and 48% of fruit exports. Tables 5.15 to 5.17 overleaf provide a summary of crop production by Governorate in the project zone of influence.

From these lands nearly 700,000 tonnes of agricultural products were handled in the Amman and Zarqa local markets as shown in Table 5.18.

Table 5.18 Movement of Agricultural Produce to Markets in Amman and Zarqa, (Tonnes)

Product	Amman Markets	Zarqa Markets	Total
Tomatoes	140812	6618	147430
Potatoes	71438	3539	74977
Cucumbers	53084	2558	55642
Mandarin	31595	1301	32896
Bananas	23504	769	24273
Apples	25137	1758	26895
Lemons	19131	1404	20535
Grapes	12360	684	13044
TOTAL	**637214**	**41317**	**678531**

Source : Statistical Yearbook, 1996, Ministry of Agriculture

In the areas of immediate impact, agriculture is typically confined to rainfed production (away from a narrow corridor along the Desert Highway). Accordingly, production is variable, given its reliance on climatic conditions; this is reflected in the wide fluctuations have been experienced in recent years. Future development prospects are therefore largely dependent on overcoming climatic constraints through the use of irrigation. However two factors may limit such expansion:

(i) there are major concerns over excessive water use for agriculture in both the JRV and the Highlands that may restrict the issuance of further well licenses.

(ii) Beyond the area in the vicinity of Desert Highway well depths increase markedly and access to water resources becomes significantly more expensive.

5.3.3 Livestock

Recent data for the livestock herd has not been obtained though data was identified, for 1987, at the Governorate level. This data is reproduced in Table 5.19 and compared with that from the NES of 1991.

Table 5.19 Estimates of Regional and National Herd, (000s)

	Amman	Madaba	Zarqa	Total	NES**	National	
						1987	NES 1991
Cattle (Local)	1.64	1.73	6.51			11.51	
Cattle (Dutch)	1.4	0.74	-		12	17.53	30
Horses	0.24	0.45	0.32			2.965	
Camels	3.0	0.15	0.5	3.65		14.32	
Goats (Syrian)	7.5	2.0	1.0	13.5		19.12	
Goats (Local)	5.0	60.0	18.0	121	170	441.0	480.0
Sheep	164.0	95.0	76.0	360	492	1219.0	1279.0

Note: ** Marginal Steppe Land
Source : Statistical Yearbook, Ministry of Agriculture 1987, NES, 1991

Table 5.15 Agricultural Areas in Selected Governorates, (000 dunums)

Governorate	Cultivable Area	Cultivated Area
Amman	2288.7	576.2
Madaba	300.0	156.0
Zarqa	300.0	281.9
Al Balqa	287.4	169.3
Total	**8870.8**	**3817.3**

Source : Statistical Yearbook, Ministry of Agriculture 1996

Table 5.16 Agricultural Production Areas (000 dunum)

		Field Crops		Vegetables	
Governorate	Tree Crops	Planted	H'vetsed	Summer	Winter
Amman	44.33	388	153	19.4	2.4
1987	*53.7*	*444.1*	*396.6*	*23.6*	*8.6*
Madaba	28.69	29	27	1.3	2.0
1987	*na*	*na*	*na*	*na*	*na*
Zarqa	40.1	52.9	36.9	7.9	3.5
1987	*40.6*	*36.4*	*35.8*	*8.7*	*3.8*
National Total	718.81	1212.0	662.8	132.36	139.1
Regional	465.02	482.8	227	31.6	9.2
% National	64.7	39.8	34.2	23.9	6.6

Source : Statistical Yearbook, Ministry of Agriculture 1996

Table 5.17 Production Area of Major Crops (000 Dunums)

	Amman	Madaba	Zarqa	National
Tree Crops				
Olives	36.17	21.23	34.06	545.43
Grapes	0.86	3.76	1.19	21.32
Apple	3.12	0.79	1.75	29.09
Peach	2.11	1.19	0.78	11.92
Fig	0.80	0.37	0.41	3.87
Field Crop				
Wheat	51.70	15.36	5.63	329.26
Barley	331.63	10.82	41.19	768.06
Lentils	1.10	3.29	0.25	43.38
Clover	-	0.12	3.81	9.94
Vegetables				
Summer				
Tomatoes	3.99	-	2.41	41.78
Cauliflower	1.88	0.13	1.25	6.67
W. Melon	5.66	-	0.90	18.84
Potatoes	1.01	-	0.09	12.35
Squash	1.59	0.63	0.54	5.49
Cucumber	1.53	-	0.09	3.09
Winter				
Cauliflower	0.59	-	1.21	6.92
Peas	0.44	1.73	0.03	2.46
Spinach	0.03	-	0.53	1.48

Source : Statistical Yearbook, Ministry of Agriculture 1996

At the National level there is almost no variation in the herd size between sources and given the absence of any reason why there should have been a major redistribution of the herd across the country it must assumed that the basic distribution pattern of 1987 held good for 1991. Similarly, the Consultants are unaware of any particular reason why the pattern should not hold broadly true today.

Although substantial herds are to be found to the west of the Desert Highway those of the eastern sections of the ARR are of far more significance.

It has been noted previously that large areas of important rangelands in this area had been ploughed up in recent years causing serious damage to the overall resource base. There are, in addition, other concerns/issues commonly identified as affecting livestock production and producers as follows:

- Traditional management practices are being modified with an increasing tendency to sedenterisation (for at least part of the year) which is leading to localised overgrazing of easily accessible areas. This is further exacerbated by the cutting of browsing bushes for fuelwood.

- Available water resources are declining as groundwater levels deepen and salinity levels in wells increase. This is now evident in the use of tankered water by grazers in the W.Ush region

- Overgrazing is contributing significantly to Desertification. Plant cover destruction (both shrub and herb cover) is occurring which rapidly translates into severe wind erosion and gully erosion in time of surface flow.

All in all the picture developed is of a damaging cycle of, an increasing tendency to concentrate herds to levels beyond effective carrying capacity, destruction of rangelands leading to concentration of herds etc.

At that the micro level it is clear that pastoralism still plays a significant role in the local economy though this traditional form of life is in decline. Three groups are identifiable:

- Nomads

This group is fully nomadic and moves to a traditional cycle that may take in excess of one year to complete. They are declining in numbers and are now expected to number less than 10% of pastoralists.

It is understood that the traditional lands utilised by this group are well to the east of the region. They may however be some joint use of lands with the semi nomadic groups from the Region.

- Small Herd Owners

These own less than 100 sheep. They are predominately settled in village communities and the herds are generally kept in proximity to the village. Labour for the management of these herds is almost exclusively derived from family members. Approximately half of family income is derived from the herds.
In total this group account for around 25 - 30% of pastoralists.

- Some 30% of the community in this area are fully occupied with the raising and management of herds. They practice a traditional way of life based on two major activities. The 'tashreeq' (movement east) starts in November each year when herds are moved into the interior to utilise the natural grazing lands. They remain in place until westward movement, the 'taghreeb' in late spring early summer when the herds feed on the remnants of agricultural crops

  This group are the most significant of the pastoralists. They own large herds and operate on a strong commercial basis but in recent years the decline in the quality and quantity of available grazing available on the rangelands has forced them to become increasingly dependent on fodder significantly increasing their costs of production.

  This group is semi settled often leaving family members in the village while taking part in the migrations. They are dependent on their herds for 90% or more of their income.

A fourth group, Traditional Farmers is also present providing the remaining 25 - 30% of those involved in Traditional Activities. They grow cereals (primarily barley but also some wheat) supplemented by a few olive trees. Most of this group have second jobs or other activities in public services or commonly, in the army and keep sheep and goats for their own consumption.

Table 5.20 provides an overview of sector activities in the region.

Table 5.20 Agricultural Activities

Group	Activities	% Resident	% Income
Traditional Farmers	Cereal only	80	4-5
	Cereals and small flock	100	50
	Cereals and medium flock	100	90
	Cereals and large flock	100	95
Pastoralists	Small flock	100	50
	Medium flock	100	80
	Large flock	100	95

5.3.4 Tourism Sector

The Tourism sector is a key economic sector in Jordan making a 10% contribution to GNP. During the last few years, as a direct result of the continuing normalisation process, the region has seen a marked revival in levels of international tourism.

The tourism figures for Jordan indicate in excess of 1 million arrivals, and that tourism receipts now represent the biggest foreign exchange earner. The city of Amman as the administrative capital and business center, accounts for about a third of the total foreign visitors to the country. This includes a large proportion of business people in addition to tourists, who are attracted to the capital as well as being part of the itinerary for visits to other sites in Jordan.

Major regional developments and improvements are underway in Jerash and in the Jordan Valley. A recent Study[6] suggests that the total number of hotel rooms in Jordan should increase to 16,000 by year 2000. Projections for year 2010 are based on three scenarios but the target figure for hotel rooms is round 26,000. The number of tourists are forecast to increase from just over 1 million at present to 2.1 million by year 2000, and to 3.8 million by the year 2010. Projected tourism receipts are estimated to increase to US $1.2 billion in year 2000 and reach $3.6 billion by year 2010.

According to forecasts from the MRPA, the number of hotels in the Region, will double and is expected to reach nearly 400 by 2020.

However, growth rates of the range of 7-10% forecast in a number of recent reports, while credible especially over the short term, will be sustainable in the medium and long term only under circumstances of full Regional integration and Sectoral co-ordination. Moreover, it is viewed as unlikely that the Eastern sections of the ARR will generate any sector specific benefits.

5.4 TRANSPORTATION AND UTILITIES

5.4.1 Transportation System

The transport sector accounts for about 11 percent of GDP, carrying all domestic goods trade, providing for tourist travel, and earning foreign exchange in its own right.

Transport infrastructure and operations in Jordan are also a key element in the effective functioning of the economy, internally, as well as for external trade. Due to Jordan's location,

[6] National Tourism Master Plan, Nippon Koei, 1996

international transit contributes significantly to economic activity and growth. Opportunities will be significantly enhanced by moves towards regional integration and co-operation brought about by increased liberalisation of trade in the region.

However with the exception of some direct rail exports of potash via Aqaba virtually all transport is by road.

The Amman area is important in terms of movements of goods. Examination of transport flows for commodities[7] indicated that traffic flows between Aqaba and Amman / Zarqa accounted for:

- Containers (loaded) : 80%
- Phosphate : 18%
- General Cargo : 41%
- Oil & Oil Products : 13%
- Empty runs : 28%

In addition, land transport imports / exports via Amman / Zarqa accounted for 12% of perishables and 65% of oil and oil products. According to the Social and Economic Development Plan, 1993-1997 the following growth rates were envisaged for different sectors:

- Services (Wholesale, retail, restaurants and hotels): 9.7 %
- Transport, storage & Communication: 7.5%

These rates are well in excess of the forecast rate of GDP of 6.1 % p.a. during the Plan period.

The provision of an Amman Ring Road has been a long-standing policy objective of the MPWH and it has been the subject of several engineering and economic studies over the last 13 years or so.

The alignment corridor for the present project is located far enough from the Amman Urban Center to include within its boundaries major suburban population centres such as Zarqa, Salt, Sahab, Wadi As Sir, Marj Al Hamam, Suwaileh, Al Baqaa and Abu Nusair. It will therefore provide a key role in linking and integrating the development routes that radiate from Amman while at the same time help reduce in flows of traffic to the centre of the city.

The corridor also intersects with all national highways that link Amman and Zarqa with the rest of the Kingdom and internationally, using Highway 15 (linking the Syrian and Saudi borders) and Highway 40 (linking the Palestinian and Iraqi borders) will be able to use the Amman Ring Road to avoid passing through Greater Amman or Zarqa.

Key specific functional aspects of the ARR are reflected in the defined objectives of the project outlined below:

[7] Goods, Trade and Transportation Facilitation Study, GOPA, BCEOM, Dioxides Associates, Phase 1. Dec. 1995

At a Strategic level,

- Facilitating the integration of transportation sub-sectors within a comprehensive approach to development planning,
- Responding to growth in the economy, regional co-operation and increasing sector development
- Complementing moves toward greater Regional transportation integration.

In a local context the road will function as:

- a regional by pass and distributor for peripheral and through traffic, thereby diverting traffic away from the central areas of Amman
- a local by pass taking through traffic away from and other urban centers such as Sahab, Fuheis, Suweileh, Salt and Zarqa, thereby reducing traffic congestion and pollution along principal urban road corridors
- a heavy truck route (possibly with legislative support) that by passes all urban areas.
- a key economic link reducing the costs of access and integration to a number of key sectors such as agriculture, industrial activity in (especially in Sahab, Hashemiya, Marka, Zarqa and the Zarqa free zone), tourism and general commerce.

5.4.2 Local Access

Local access patterns vary significantly across the region and can be defined as follows.

A Desert Highway - Muwaqqar Highway

The local area network in this Section is extensive and well developed with road crossing of a vehicular access on average every 600m. Virtually all communities are interlinked as are centres of activity. Alternative routings would be available in most cases but routes would be longer and a number of unengineered tracks would need to upgraded if existing levels of service are to be maintained.

B Muwaqqar Highway - Zarqa

Beyond narrow corridors of development fronting existing highways this area is largely undeveloped. Access to the interior, where provided, is by rural roads that are occasionally surfaced. Other access is provided by a network of unengineered tracks developed along desire lines by local land users. Little or no permanent agriculture is undertaken and there are few developed properties requiring access.

There is therefore only a rudimentary network to be disrupted. Where interference does occur it will be in the form of severance especially of animal movements, rather than vehicular access.

C Urban Areas / Development Corridors

This zone comprises two distinct areas:

- Zarqa Urban Area

Although each of the various alternative options for the alignment effectively by pass Zarqa they will have an important impact on both local network access and private access. There will in particular be substantial disruption in the vicinity of the Zarqa by Pass and at all interchange options. All users will be adversely affected and in some cases problems can be expected from having to accommodate both heavy vehicle and pedestrian access needs in the design process.

In these cases detailed studies will be required to ensure that the access available to sites at all times, is appropriate and safe. Preservation of local access routes will be less problematic.

- Industrial Area

As indicated in Section 2 this existing highway could be upgraded to form the western leg of an ARR. Such an option in these developed and rapidly developing areas would undoubtedly have major implications for local access and would need to be the subject of highly detailed studies at both the preliminary and detailed design phase.

5.4.3 Utilities

Figure 5.2 shows the principal utilities lines in the region and unsurprisingly, given the 'ring' nature of the project and the fact that 60% National population live within the ring the pattern is relatively complex.

Broad indicators of the level of service for areas of the Study Area are provided in Tables 5.21 and 5.22.

Table 5.21 Level of Utilities Service Provided, % of Occupied Dwellings

Sewage

	Public	Cess Pit	Other	None
Madaba	43.21	52.21	0.40	4.17
Zarqa	69.35	29.05	0.42	1.22
Amman	74.12	24.97	0.08	0.83
Total	**68.73**	**29.38**	**0.34**	**1.55**
National	**52.40**	**44.38**	**0.44**	**2.77**

Water

	Private Tap	Public Tap	Tanker	Well	Other
Madaba	91.98	0.54	4.02	1.60	1.87
Zarqa	96.17	0.22	2.31	0.63	0.67
Amman	96.86	0.40	2.06	0.32	0.36
Total	**95.87**	**0.38**	**2.59**	**0.51**	**0.64**
National	**94.02**	**0.53**	**2.86**	**1.36**	**1.23**

Source: General Census of Population and Housing 1994

5.5 Housing

The characteristics of the housing stock in the Region are indicated in Tables 5.23 to 5.25 which provide data on the housing type and size.

Table 5.23 Housing Type (%)

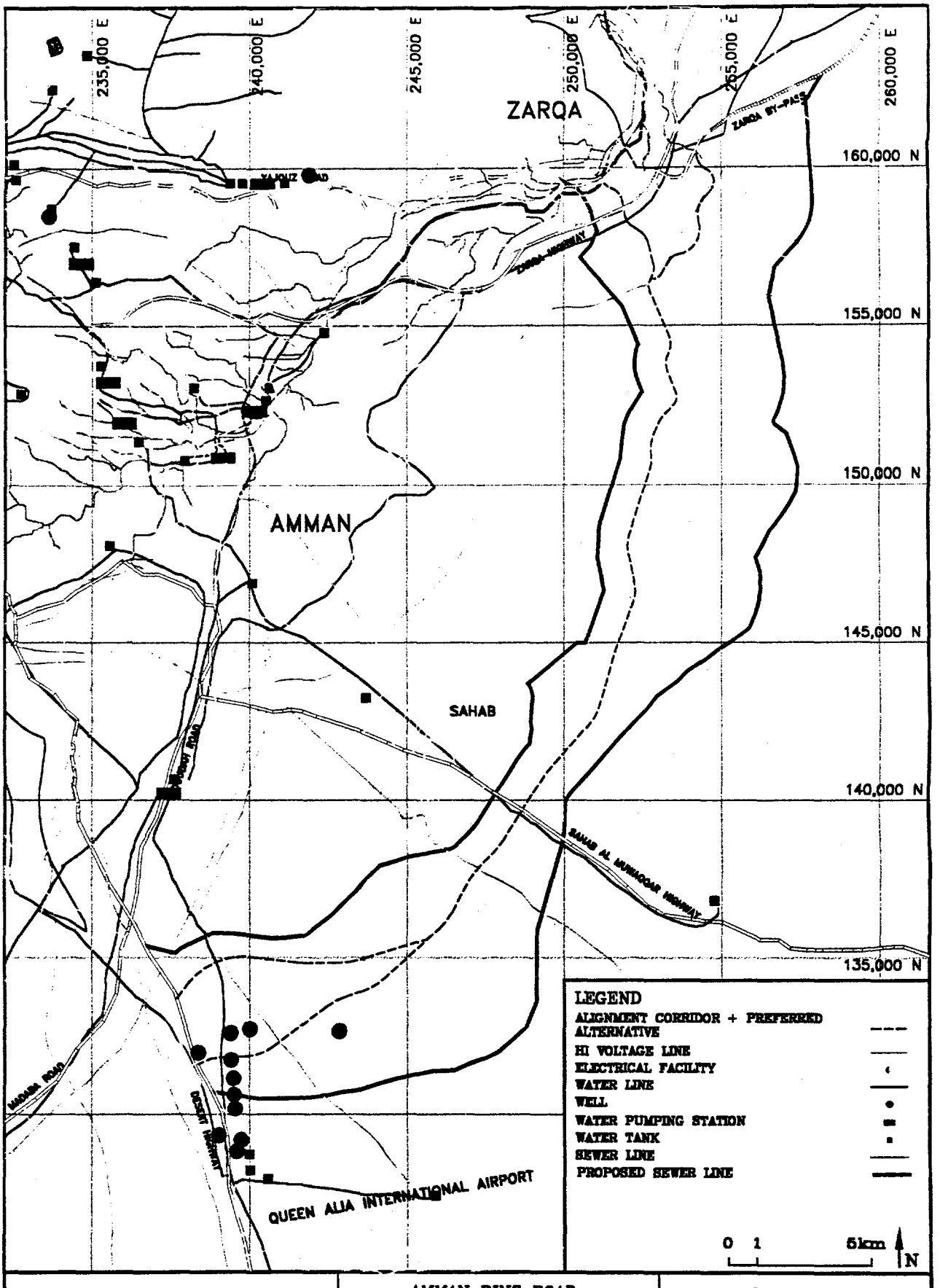
	House	Apartment	Villa	Tent	Other
Madaba	58.78	38.19	0.37	1.36	1.38
Zarqa	31.06	67.19	0.34	0.55	0.87
Amman	17.48	78.38	2.75	0.23	1.17
Total	**27.75**	**65.75**	**4.75**	**0.58**	**1.17**
National	**40.07**	**56.17**	**1.35**	**1.03**	**1.37**

Source: General Census of Population and Housing 1994

Table 5.24 Area of Housing Unit (m^2) % by Category

	< 50	50-99	100-149	150-199	200-300	300-400	500+
Madaba	14.76	27.48	31.82	17.23	7.18	1.13	0.40
Zarqa	11.94	38.30	32.29	11.19	5.16	0.86	0.25
Amman	14.80	32.35	27.47	14.05	7.97	2.56	0.81
Total	**14.84**	**33.28**	**28.56**	**13.47**	**7.22**	**2.01**	**0.63**
National	**14.58**	**30.93**	**30.79**	**14.53**	**7.04**	**1.65**	**0.49**

Source: General Census of Population and Housing 1994



AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 6.2

PUBLIC UTILITY NETWORK

Table 5.22 Utility and Selected Social Facility Provision

	Power	Water	Direct Phones	Operator Phones	Schools	University	Sports/ Cult. Clubs	Charitable Societies	Community Centre
Zarqa	X	X	X		X		X	X	
Birain	X	X	X		X				
Al Hashemiya	X	X	X		X		X	X	
Maqam Issa	X	X	X						
Sabeer	X	X							
Um Rummaneh	X	X		X					
Marhab	X	X		X					
Um Fatayeh	X	X							
Shoumar	X	X							
Balqa	X	X	X		X		X	X	X
Fuhais	X	X	X		X		X	X	
Mahes	X	X	X		X				
Um Dananeer	X	X	X						
Al Hanou	X	X	X						
Baqa'a Camp	X	X	X		X		X	X	
Naur	X	X	X		X	X	X	X	
Balaass	X	X							
Wadi Rubia									
Um Al Basateen	X	X		X	X				
Wadi es Sir	X	X	X		X		X	X	
Wadi Sheita	X	X							
Um Abhara	X	X							
Abu- Sous	X	X							
Marj Al-Hammam	X	X	X		X		X	X	

Table 5.25 No. of Housing Units per Structure and No. of Floors per Housing Unit (%)

	1	2	3-6	7+
Madaba	16.71	8.63	0.16	0.07
No. Floors	*22.17*	*3.93*	*0.05*	*0.00*
Zarqa	24.48	21.21	0.93	0.29
No. Floors	*32.18*	*15.00*	*0.09*	*0.00*
Amman	22.59	28.96	4.52	1.47
No. Floors	*34.07*	*24.38*	*0.27*	*0.00*
Total	**22.09**	**22.58**	**2.68**	**0.87**
No. Floors	***31.17***	***17.71***	***0.18***	***0.00***
National	**19.88**	**15.75**	**1.57**	**0.55**
No. Floors	***26.39***	***11.29***	***0.13***	***0.00***

Source: General Census of Population and Housing 1994

These values again present an entirely expected picture:

- the majority of apartments and multi household structures are in the predominantly urban areas of Amman and Zarqa. Nevertheless, even in these areas less than 5% of structures have greater than two floors. In rural areas 'houses' are the dominant accommodation though in Balqa there has been strong growth in the number of villas.

- Housing units are predominantly in the range of 50 - 150 m^2 in all areas (52%) though the relatively high proportion of villas in Balqa provides some distortion in the figures for that Governorate.

Building construction is generally sound, and of adequate quality (i.e. not Marginal or Temporary, Table 5.26) and with the service provision indicated there are few serious problems evident in the basic housing statistics.

Table 5.26 National Housing Stock Quality % by Category

Type	Greater Amman	Other Urban	Rest	Total
Typical	34.46	37.27	26.22	97.95
Marginal and Temporary	0.35	0.72	0.98	2.05
Total	34.81	37.99	27.20	100

Source: Ministry of Planning, National Housing Strategy, 1987

However, past survey data, notably that of the GACDP noted a tendency for the smaller households to occupy the larger dwellings (mainly in the north western and western suburbs) and vice versa with the smallest units in the eastern suburbs. While there is no data available to confirm these conclusions today there is sufficient information available in the Census data to suggest that such a distribution would hold good. Moreover, the relatively high levels of occupancy reported in 1985 in the smallest units are also likely to persist given that family sizes are still relatively large and the population is exceptionally young.

5.5.2 Tenure Status

The tenure status of the residents of the Study Area is outlined in Table 5.27 where the findings of the 1994 census are compared to those of the GACDP survey of 1985.

Table 5.27 Tenure Status of Occupants, % by Category

	Owned	Owned by Hhold mbr. or mbr. for allotments	Rent Furnished	Rent Unfurnished	Other
Madaba	66.32	13.33	0.19	17.09	3.08
Zarqa	59.14	5.87	0.19	31.52	3.27
Amman	51.67	6.78	0.93	36.42	4.20
Total	55.48	7.01	0.66	32.81	4.03
National	59.87	7.65	0.56	27.95	3.97
GACDP	63.3		28.8		7.9

Source: General Census of Population and Housing 1994, GACDP, 1985

The data between the years is broadly consistent with around 60% of heads of households (or immediate relatives) owning the dwelling unit they occupy. There is however insufficient data available to suggest whether there is real trend towards greater house ownership or whether the slight rise is due to differences in definition and classification. The GACDP project survey reports also noted a tendency in some areas for there to be significantly higher densities of persons per room in owner occupier dwellings than in rented accommodation. This is not unexpected and would probably hold true today.

Data on the length of residence shown in Table 5.28 presents a pattern in keeping with that of the other data. Specifically, a relatively low proportion of residents of < 5 years occupation in Madaba reflecting the essentially rural nature of the economy and probable lack of in migration. Elsewhere the pattern is remarkably consistent with the higher values for Amman 5-10 years ago probably reflecting its greater attraction for returnees from the Gulf States.

Overall, the data suggests a very stable market with households moving infrequently.

Table 5.28 Length of Residence, % by Category

	Years of Residence				
Governorate	**<5**	**5-9**	**10-19**	**20-29**	**>30**
Madaba	36.45	20.75	24.65	13.02	5.13
Zarqa	42.89	23.18	22.49	9.26	2.18
Amman	42.24	24.58	19.66	9.54	3.99
Total	**42.07**	**23.77**	**21.14**	**9.53**	**3.50**
National	**40.09**	**22.93**	**22.75**	**10.49**	**3.74**

Source: General Census of Population and Housing 1994

5.6 LAND USE

5.6.1 Corridor Land Use Structure

The land use structure of the corridor, as well as much of the surrounding area, is to a large extent controlled by the prevailing economic activity, topography and soils. The south eastern quadrant between the DH and MH has been and is continuing to be the subject of relatively recent planned actions responding to contemporary requirements. The areas to the west tend to be older, more organic settlements growing in response to their agricultural economies as well as the prevailing and restrictive topography.

The north eastern corner of the corridor is the closest it comes to the main urban elements of the conurbation. The development activity in the area of Zarqa and the Wadi Al Ush is a

mixture of declining agriculture and growing mixed industry, including a variety of salvage and scrap metal activities. More sophisticated activities including pharmaceuticals, chemicals and metal fabrication are also present. No structured settlements are located directly in this part of the corridor. Further to the east beyond the corridor there is a large Industrial Free Zone located to take advantage of this location which is adjacent to the international roads to both Iraq and Syria.

Immediately to the south of W. Ush and west of the corridor is a large area of land allocated for quarrying purposes. Further south the corridor is beyond the urban area and only small villages, largely dependent on agriculture exist there. An extensive and largely completed industrial area at Sahab is located inside the corridor along the Sahab to Al Muwaqqar Highway.

This pattern is clearly reflected in Figure 5.3 which provides a summary of land uses within the alignment corridor.

From a land use planning perspective, the main issues inherent in this structure are identified are as follows:

- a general deficiency in public open space and landscaped recreation areas and the lack of an overall urban landscape and open space structure;;
- inconsistency in urban development standards, resulting from the flexible interpretation of zoning and building regulations;
- a mixture of incompatible uses, resulting from imprecise zoning regulations and, in a limited number of locations, illegal development.
- continued urban expansion on to agricultural lands

5.6.2 Development Opportunities

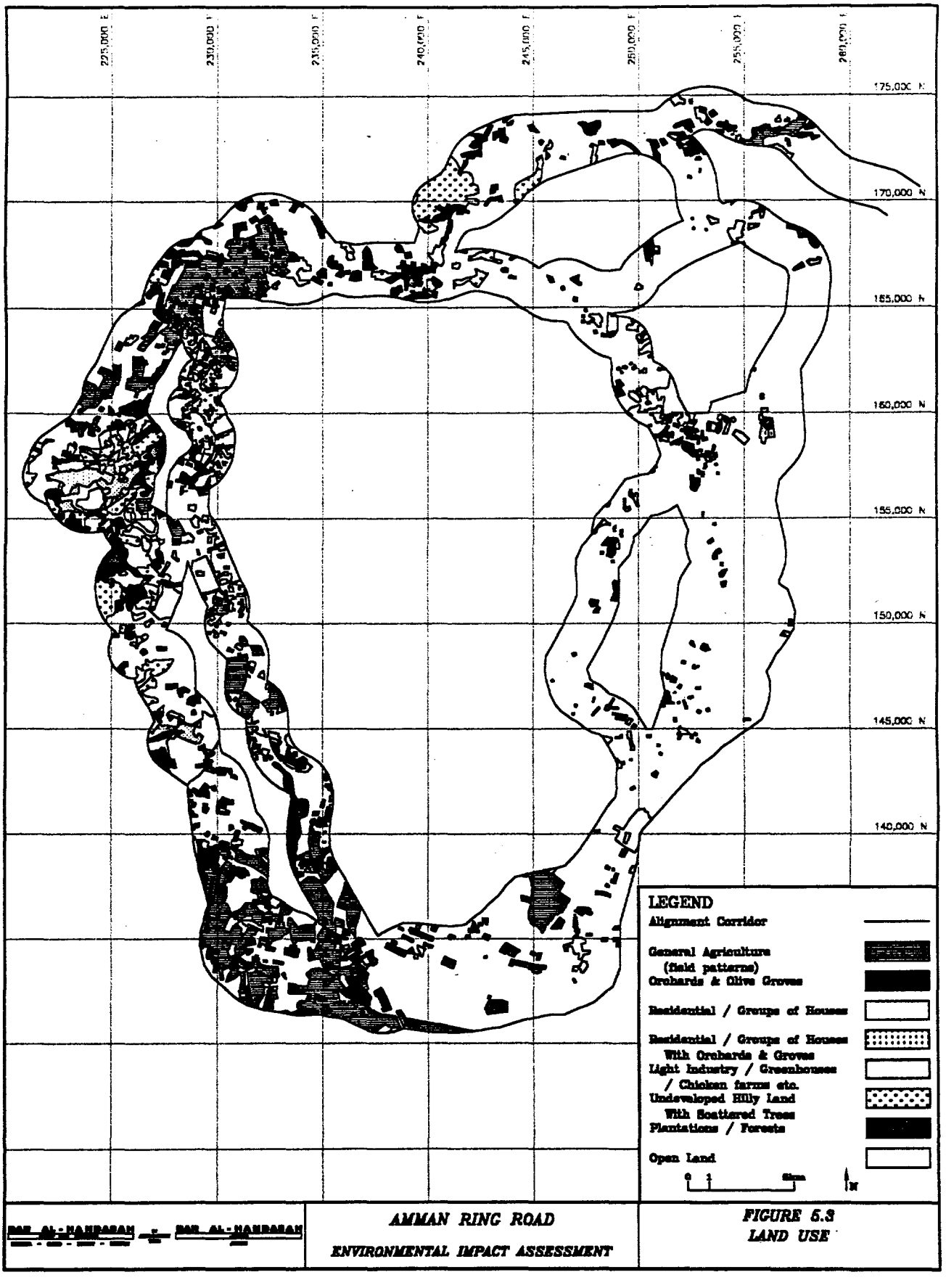
The eastern side of Amman is already the subject of extensive urban development whose growth prospects would be further enhanced by the construction of the ARR. Significant opportunities for physical development exist in the eastern corridor where activities are less constrained by topography and strategically important activities like agriculture, than in the west, particularly in the areas around Sahab.

5.7 SOCIAL INDICATORS

This section provides a brief overview of the socio economic conditions prevailing in the study area. However, in a number of contexts, data was unavailable at the local (or any sub-national) level. For a significant proportion of the section therefore the issues are addressed using National, Jordanian data.

Given the dominance of the Study Area in the country[8] it is considered that little is lost in this approach in terms of the validity of the data when applied to the study area as a whole, however it does imply that there is little capacity available for comparison of circumstances within the Study Region. In the light of this international comparisons are made available to provide some context for the analysis.

[8] By virtually any measure, economic activity, population, urban development etc.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LEGEND
Alignment Corridor
General Agriculture (field patterns)
Orchards & Olive Groves
Residential / Groups of Houses
Residential / Groups of Houses With Orchards & Groves
Light Industry / Greenhouses / Chicken farms etc.
Undeveloped Hilly Land With Scattered Trees
Plantations / Forests
Open Land
0 1 5km
N
BAB AL-HANDARAH
BAB AL-HANDARAH
AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT
FIGURE 5.3
LAND USE

5.7.1 Income

Tables 5.29 and 5.30 provide estimates for the average income in the Study area in 1994, per person and per household.

Table 5.29: Average Income per year per person: 1994 (JD)

Sources of Income	Amman / Madaba	Zarqa	Jordan	Region.
Employment	366.00	298.5	328.6	328.5
Private Sources	125.70	66.7	86.7	91.9
Grants	167.20	97.7	117.9	116
Ownership	25.60	8.7	13	19.1
Other regular	79.50	67.5	64.6	72.6
Others Incomes	0.90	0.30	870	0.5
Total	764.7	539.4	612	628.8

Source: Department of Statistics

Table 5.30 Average Income per year for Jordanian Households: 1994

Sources of Income	Amman / Madaba	Zarqa	Jordan	Region
Employment	2,185.40	1,904.30	2,053.50	2,064.7
Private Sources	750.4	425.60	574.30	539.6
Grants	998.2	623.30	725.30	734.3
Ownership	153	55.20	119.40	79.4
Other regular	474.7	430.30	454.00	404
Others Incomes	5.10	2.20	3.40	5.37
Total	4,566.8	3,441.3	3,929.9	3,827.5

Source: Department of Statistics, 1996

In an international context, using GNP rates per capita as a substitute value for income, Jordan is moderately well off falling at the midpoint in a Regional analysis and although some caution must be expressed about using the data in Table 5.31 because of the effects of the Gulf War on regional economic statistics for the period, there is no compelling evidence of serious economic stress on behalf of the population as a whole.

Table 5.31 GNP Values as Indicators of Relative Wealth

	GNP		PPP estimates of GNP per capita $US = 100			Poverty, As % of people
Country	Per capita	Gwth 1985 - 95	1987	1995	Current Int'l $ 1995	living on < $1 / day
Egypt	790	1.1	14.3	14.2	3820	7.6
Morocco	1110	0.9	13.2	12.4	3340	1.1
Syria	1120	0.9	18.5	19.7	3320	n/a
Jordan	**1510**	**-4.5**	**23.8**	**15.1**	**4060**	**2.5**
Tunisia	1820	1.9	18.3	18.5	5000	3.9
Lebanon	2660	na	na	na	na	na
S. Arabia	7040	-1.9	43.0	na	na	na

Source: WB: World Development Report, 1997, Table 1

Conversely, however, the Jordanian National Report to UNCED, 1992, suggested that in 1990, some 18% of the population were living in poverty, up 3% in the decade since 1980.

Whatever, the true case, the GOJ has identified the issues of poverty and unemployment as deserving of the highest attention in the development process. This is reflected in the recent decision to establish the social security safety net and in efforts to attract quality, job creating investment, rather than simply investment.

Data on the scale of the problem is difficult to come by but persistent unemployment rates of around 15% are commonly reported in the media and appear to generally recognised as being of the right order of magnitude. Records from the Zarqa survey indicated 15% unemployment.

Given this it is certain that within a study area so relatively extensive (in terms of the percentage of national population covered) there will be unemployment hot spots where rates of 20% or more will be experienced. Similarly, concentrations of other socially disadvantaged groups may be expected.

5.7.2 Education

Table 5.32 contains data on the level of educational achievement in Jordan in comparison to other countries in the region.

Table 5.32: Education Enrollment Rates, 1993

	Adult Illiteracy % (1995)	Enrollment Rates as % of Age Group				
		University	Secondary		Primary	
		F & M	F	M	F	M
Jordan	13	**19**	**54**	**52**	**95**	**94**
Syria	na	18	42	52	99	111
Egypt	49	17	69	81	89	105
S. Arabia	37	14	43	54	73	78
Tunisia	33	11	49	55	113	123
Morocco	56	10	29	40	60	83
MENA Ave.	39	14	51	65	91	103

Source, World Bank World Development Report, 1997, (Table 7)

From this Table it is clear that the efforts of the government in the field of education are yielding positive returns at the higher levels of the system though there are nevertheless frequently expressed concerns over the quality of some of the training received at this level.

The results of the basic education system are perhaps most adequately reflected in the prevailing rate of adult illiteracy. By this criteria Jordan, compares favourably with any country in the region and many wealthier countries elsewhere.

5.7.3 Public Health

During data collection the Consultants were unable to identify any existing data source that permitted the incidence of particular diseases to be localised to specific geographic areas and thus specific population sub groups. It has not been possible therefore to undertake any

statistical analysis that would define causal linkages between the characteristics of an area[9] and health problems. Accordingly the assessment provided is general in nature.

The incidence of indicator diseases in Jordan is shown in Table 5.33.

Table 5.33: Incidence of Indicator Diseases, 1992 - 1996

Disease	1996	1992	1993	1994	1995
Typhoid fever and Paratyphoid	141	159	439	157	155
Cholera	-	-	-	-	-
Infectious Hepatitis	1618	720	1569	1636	722
Meningitis: Epedemical and Non Epedemical	948	204	218	238	482
TB Infections	347	379	294	334	397
Childhood Polio	-	16	1	4	-
Dysentery	913	321	422	526	561

Source: Statistical Yearbook, 1996

In reviewing Table 5.33 the following broad conclusions can be drawn:

- Hepatitis has now grown in to a major public health threat to all members of the population.
- The major epidemic diseases, Cholera and Typhoid are clearly under control and while they will always remain a threat, the conditions for a major outbreak of either disease are not generally in place.
- Gastro-enteritic complaints and diarrhea remain a concern.
- Overall patterns of disease occurrence are not indicative of pervasive poverty.

These conclusions are also reflected in the trends in infant mortality and maternal morbidity summarised in Table 5.34.

Table 5.34: Trends in Infant Mortality and Maternal Morbidity

	Infant Mortality			Maternal Morbidity; per 100 000 live births	
Year	1975	1986	1994/5	1979 /80	1989- 95
Yemen/North Yemen as appropriate	171	136	80.92	1000	1471
Jordan	**65.6**		**31**	**n/a**	**132**
Egypt		132.3	56	500	n/a
Morocco		91.2	55	327	372
Tunisia	79.8		39	1000	138
Syria	64.6		32	280	179

Source: World Bank 1996.

5.7.4 Women in Work and Development

The right of women to work and participate in the development process without hindrance or discrimination is established in Jordanian legislation[10]. Despite this it is clear from the available

[9] e.g. Air Pollution, or more commonly, sanitary conditions, access to piped water, housing density, income, etc. or combinations thereof.

data, Table 5.35 that women have either been unable, or have not desired, (or both) to participate fully in the workplace. However as is shown in the Table unlike most comparable countries, there has been a relatively significant upward change in these values of the last 15 or so years.

Table 5.35: Females as % of Labour Force

Country	1980	1995
Morocco	34	35
Tunisia	20	30
Egypt	26	29
Yemen	33	29
Lebanon	23	28
Syria,	23	26
Jordan	**15**	**21**
Saudi Arabia	8	13
MENA average	24	26

Source: WB: World Development Report, 1997, Table 4

There are a number of factors that may still be perceived to restrict participation. Firstly, a persistent societal perception of woman's primary role as in the home to the extent that that is where the woman will inevitably end up. This argument is usually supported by the secondary view to the effect that in this case education is not a necessity for women. However, for Jordan this argument is not consistent with the data on adult literacy shown in Table 5.35 which shows low levels of illiteracy among women, suggesting extensive exposure to at least basic education.

Table 5.36: Adult Illiteracy Rates in Jordan and Comparable Countries

	F	M
Jordan	**21**	7
Morocco	69	43
Egypt	61	36
Yemen	76	36
Saudi Arabia	50	29
Tunisia	45	21
Syria,	44	14
Lebanon	10	5
MENA average	**50**	**28**

Source: World Bank World Development Report, 1996, (Table 7).

Conversely, there are indications in other statistics of a very strong pre-eminence for the home keeping role. This is reflected in the relatively young age of first marriage and very high total fertility rates shown in Table 5.37.

[10] With the possible exception of the Personal Status Law and the Penalty Law, and the Ministry of Labour Directives that define occupations from which women excluded on the grounds of personal safety; truck drivers, handling dangerous chemicals, etc. It should be noted that these Directives do not apply to an owners own business.

Table 5.37: Female Age of First Marriage and Fertility Rates

	Age of First Marriage		Total Fertility Rate
	1987	2000 estim.	1986
Yemen	20.72	7.2	8.7
Saudi Arabia	n/a	5.9	7.1
Syria	21.1	4.2	6.9
Jordan	**21.5***	**4.2**	**6.0**
Egypt	21.3	3.5	4.6
Morocco	21.3	3.5	4.5
Tunisia	23.9	3.3	4.4

Note * 1996
Source: World Bank World Development Report, 1996, (Table 28), Statistical Yearbook, 1996

Such characteristics are traditionally assumed to combine to reduce education opportunities (especially at the secondary level and above) and limit female skill development opportunities and equally importantly their availability to work.

Secondly, conflict with the traditional view that the man is the income earner, exacerbated by both, the potential social stigma that may be attached to a man whose wife is either the sole or part income earner, and the potential competition for some between men and women for jobs.

In addition, to the general constraints imposed on participation in the labour market, women also appear to be disadvantaged in that where they do participate they are not fully utilised. In general terms women tend to be employed in the public sector, frequently in 'reserved occupations' where they have little opportunity to develop a professional career and or where their potential is rarely fully realised.
Finally, the data shown in Table 5.38 suggests that there a relatively small percentage, (9.6%) but significant number of female heads of household in the region (41,000) a factor that may need to be noted in designing project related programmes intended to minimise adverse impacts, especially in the context of potential land acquisition and resettlement needs.

Table 5.38: Female Heads of Household

	Male	Female	Total	Female %
Madaba	14840	1408	16248	8.67
Zarqa	91321	10050	101371	9.91
Amman	243224	25671	268895	9.55
Total	388446	41101	429547	9.57
National	602427	63913	666340	9.59

Source: General Census of Population and Housing 1994

SECTION 6:

TEMPORARY IMPACTS

SECTION 6: TEMPORARY IMPACTS

6.1 INTRODUCTION

This Section addresses the temporary impacts of construction, i.e. those impacts related to the construction phase only. These are assessed under five broad headings,

(i) on site
(ii) demolition
(iii) use of explosives
(iv) off site works, and
(v) resource consumption.

On site impacts are those related to works carried out within or, in the case for example of drainage channels, physically connected to the ROW established for the road and off site impacts relate to those accruing to activities divorced from the ROW, but directly linked to the project, e.g. raw material extraction sites. Resource consumption is self explanatory but relates specifically to the significance of the consumption in the context of the local, regional and national resource base.

6.2 ON SITE WORKS

6.2.1 General

The construction phase of the project may cause a number of adverse impacts. These would include impacts related to clearing and loss of vegetative cover, and grading or roadbed construction, such as, erosion and consequent increased stream sediment load; foreclosure of other land uses, the temporary modification of drainage patterns, air and soil pollution from asphalt plants, noise from construction equipment, and dust. It is also necessary that the construction sites themselves are made safe, both to construction workers and to members of the public.

For the purposes of this study the potential impacts of the construction phase are defined under ten broad headings:

- Landscape Damage
- Damage or Destruction of Sites of Archaeological and Cultural Interest
- Dislocation of Existing Communications
- Utilities
- Access Road Construction
- Soil and Water Pollution
- Drainage, Erosion, Turbidity and Sediment Load
- Disposal of Surplus Materials
- Noise and Air Pollution
- Public safety

6.2.2 Landscape Damage

Landscape in this context refers to all elements of the landscape, both human and physical, not elsewhere specified, and landscape damage, to two cases:

(i) unnecessary damage caused by construction activities.
(ii) the condition of the landscape after completion of construction

In case (i) a wide range of types of damage may be incurred, including:

- destruction of natural vegetation
- damage to natural habitats
- destruction of productive lands
- damage to private property
- damage to cultural & historical resources.

In general terms unnecessary damage is damage caused outside of the project right of way and other defined areas of operation. In most cases such damage will be caused by deliberate and inappropriate activities such as, deviation from defined access routes, or accidentally, by the careless operation of equipment and poor management and supervision of the site allowing clearing etc., to occur, in error outside of defined project limits.

In case (ii) the primary concern is the condition of the site (landscape), after completion of construction works. Particular causes for concern would include:

- scarring of the landscape; unsightly and a potential source of future erosion concerns
- presence of abandoned equipment or material; unsightly, potentially dangerous to future land users and potentially polluting.
- presence of spoil heaps; unsightly, potential sources of additional sediment load and potentially dangerous to children etc.
- presence of untreated borrow pit sites; unsightly, potentially dangerous with uncontrolled access, potential breeding ground for insects.

6.2.3 Damage or Destruction of Sites of Archaeological and Cultural Interest

According to data provided by DAJ there are 24 historical or cultural sites that may be directly by the proposed project. It is however, not impossible, given the long history of settlement in the region, that further archaeological or cultural resources may be discovered in the ROW, or within the wider zone of likely construction activities, adjacent to, or in the ROW of proposed access roads, during the course of construction.

6.2.4 Dislocation of Existing Communications

All roadways, pedestrian footpaths and animal husbandry trails (or less specifically animal movement patterns in general) crossed by the proposed road will be subject to some impact. The impact will take one of three forms:

- permanent closure,
- temporary closure and diversion for a limited period during actual construction.

- partial closure with consequent delays in use for a limited period during actual construction

The effects of severance during, and post construction are similar, and to avoid repetition are addressed in detail, only once in this report, in Section 7. This section contains only a brief overview of the nature of the impacts.

At this stage of the project it is not possible to know the exact timing and duration of the temporary and partial closures required. It is not practical, therefore, to review the impacts of specific cases.

It is important here, however, to distinguish between dislocation to vehicular and non vehicular movement. With vehicular movement the impacts will be confined to potential increases in the time and costs of journeys and minor inconvenience. Valuation of these disbenefits can be obtained from the estimated additional time and VOC incurred in utilising the diversion or the impacted crossing.

The impacts of severance on non vehicular movement are potentially much more significant but are less easily quantifiable. They will include losses to the productive sector and rural community severance. For example, several areas affected by the road, utilise animals extensively for traction and personal transport and as such do not confine movement to existing roads. Diversions in these cases may add considerable time to journeys.

Animal movements appear to be relatively unrestricted throughout those parts of the corridor dominated by rainfed agricultural systems and will therefore be seriously affected by the project construction. Insufficient attention to the requirements for animal movement may cause major long term problems and also hinder the construction effort.

6.2.5 Utilities

The proposed project crosses a large number of utilities facilities. Table 6.1. below provides a listing of known utilities crossings/ impacts as of June 1998.

Table 6.1 Listing of Known Utilities Crossing Sites

Utility	Chainage
Voltage Electricity Cables	MR 2+400, RR 2+850 Sec. 1 11+250, Sec. 2 18+400 ZEB 4+350, ZEB 5+100, ZTR 0+075
Water transmission pipes	MR 0+550, RR 0+500 Sec. 1 13+150 ZEB 5+100, ZTR 0+075, ZTR 0+950
Telephone Lines	Sec. 1 13+200 ZTR 0+050, ZTR 0+950
Sewage Lines	ZTR 0+900

Many of these utilities will impose specific constraints on the design of works and the execution of works. The potential severity of the impacts of damage to the utility varies greatly for each facility and is defined in Table 6.2.

Table 6.2 **Potential Severity of Impact of Damage to Utilities Infrastructure**

Facility	Impact of Damage	Severity of Impact
High Voltage Elect	Interruption of Supply	Widespread productive losses and inconvenience to the public
	Personal Injury	Likely death of operator
	Expense of Repair and delay to works	Very Severe
Medium Voltage Elect	Interruption of Supply	Significant productive losses and inconvenience to the public
	Personal Injury	Likely death of operator
	Expense of Repair and delay to works	Severe
Low Voltage Elect	Interruption of Supply	Localised but significant productive losses and inconvenience to the public
	Personal Injury	Likely death of, or serious injury to operator.
	Expense of Repair and delay to works	Minor
Major Water Transmission Pipes	Interruption of Supply	Widespread productive losses and inconvenience to the public.
	Expense of Repair and delay to works	Very Severe
Water Distribution Mains	Interruption of Supply	Potentially significant productive losses and inconvenience to the public.
	Expense of Repair and delay to works	Severe
Local Water Distribution	Interruption of Supply	Localised but significant inconvenience to the public
Telephone cables	Interruption of Supply	Disruption to national and international Telecommunications.
	Expense of Repair and delay to works	Limited
Telecommunications Cables	Interruption of Supply	Extreme disruption to national and international Telecommunications.
	Personal Injury	Nil to minor
	Expense of Repair and delay to works	Very Severe

6.2.6 Access Road Construction

Access roads may be required to be built during the construction period. However at this stage of the project it is not possible to define the requirements for such roads, if any. Accordingly the impacts defined are generic and do not apply to specific access roads. In all cases it is assumed that access roads will be unsurfaced.

If incorrectly constructed or routed, access roads may have a number of unnecessary impacts, e.g.:

- loss of productive lands
- disruption of productive land management
- damage to natural habitats
- destruction of natural vegetation
- damage to private property
- damage or destruction of sites of archaeological and cultural interest
- damage to utilities

In terms of foreclosure of land uses each kilometre of access road of say 10m width will, at least temporarily, foreclose 1 hectare of land from other uses.

More specific causes of concern would include the potential for increasing levels of erosion and sedimentation and dust generation. In the former case the major concerns relate to potential damage in the post construction period. If the road is left and not maintained it will in time act as a surface drainage channel. In these circumstances it is likely that localised changes to the drainage pattern and regimes will occur. Similarly the cleared area of the road will be susceptible to very high rates of erosion and sediment generation.

The potential significance of the threat from an abandoned access road will depend greatly on the road profile and the stability of the soils on which it is constructed.

In the latter case the soils of the study area are known to be vulnerable to pulverisation and will turn to a fine powdery dust in summer. Dust abatement measures will therefore be required during construction operations.

6.2.7 Soil and Water Pollution

Soil pollution, by chemicals is a relatively minor issue and is most likely to occur in the vicinity of asphaltic plants as a result of equipment leakage and spills. In most cases if attended to within a reasonable time frame it will not be a significant impact.

The principal cause for concern is the pollution of water courses and groundwater resource by chemicals related to construction activities. These will include; asphalt, bitumen and other petroleum based products.

Diversion of subsurface flows, abstraction for construction use (see Section 6.6) and pollution during construction are unlikely to seriously affect existing use patterns to the detriment of productive land users.

6.2.8 Drainage, Erosion, Turbidity and Sediment Load

Temporary dislocation of existing drainage patterns is inevitable during the construction phase as cut and fill operations take place. If proper care is not exercised, in the planning and execution of the construction phase, to provide for sufficient cross drainage, construction activities may lead to the following impacts

- ponding; localised potential threats to human health, over concentration of animals and potential damage to surrounding soils and vegetation
- localised raising of water tables; increased threat of pollution and the presence of localised surface water
- in extreme cases flooding upstream of construction activities with consequent damage to productive lands, private property etc.

In areas in the vicinity of existing wadi courses and in the higher energy environments of Wadi Ush increased erosion and sedimentation levels may be viewed as a most serious potential impact. Increased erosion may stem from a number of actions:

(i) Use of temporary discharge points

Since it is likely that local drainage patterns will be altered significantly during construction, particularly in areas of significant cut and fill, (greater than 8m), temporary discharge points may be required to provide temporary drainage for the site. Inappropriate location and design of the discharge points may lead to serious downstream erosion and increased sediment load.

(ii) Site clearing

Removal of surface vegetation in the ROW will be unavoidable but will increase short term erosion levels and sediment loads. The severity of the impact will depend on the slope gradients, soil type and the length of time, and seasonality, (dry season or wet season), of exposure.

(iii) Cut and fill and all operations in unstable and erosion prone areas

In the generally stable conditions of the alignment landslips, slumps or other mass movement of materials are not anticipated. However there is some potential concern over cut operations within the narrow and well defined main valley of northern Wadi Ush where slumping may cause blockage and diversion of flows.

Fresh cut slopes are highly conducive to erosion, being by definition of steep slope and bare faced. Freshly constructed embankments are similarly vulnerable to erosion. Particular care will be required in cases where road cuts intercept perched water tables, springs and other subsurface drainage features, to ensure that subsoil conditions in surrounding areas are not adversely affected.

(iv) Aggregate, Fill and Spoil Heaps

The risk of material losses from aggregate, fill and spoil heaps stored prior to use or disposal is considerable. These heaps represent large sources of loose, unconsolidated material that are highly susceptible to erosion (air and water) and hence sediment transport.

6.2.9 Disposal of Surplus Materials

No cut and fill balances are available for any section of the project. However the following broad conclusions may be drawn.

- The MR, RR and Section 1 will have a fill shortfall which is estimated at between 0.75 and 1.0 million m^3 (assuming 1.5 to 2m fill by 50m by 10kilometres)

- The ZEBP has a slight excess on the main line but it is likely that this would be utilised elsewhere, at interchanges and such like. An overall balance is therefore assumed.

- A similar situation exists with the ZTR where the mainline will have a fill surplus of around 50,000m^3 that can be readily utilised at the interchange sites.

The position is less clear cut for Section 2 where small adjustments in the main line alignment or design approach may substantially revise the projected budget. Nevertheless it is not

expected that a major surplus would be expected and that even if it were to occur disposal in the quarried areas of the region would be entirely appropriate and could form the nucleus of a landscaping /area rehabilitation scheme.

6.2.10 Noise and Air Pollution

Certain levels of noise and dust pollution are unavoidable at major construction sites. In excess, however, they can be a nuisance to both, construction workers, and neighbouring residents or workers and, in extreme cases, can become a health hazard.

Typical noise emissions (dB(A))from the plant anticipated to be in use are as follows:

	Distance			Typical International Standard		Exceedance	
	5m	20m	50m	Day	Night	Day	Night
Loader	90	78	70	75	55	-	15
Grader	90	78	70	75	55	-	15
Vibration Roller	86	74	66	75	55	-	11
Bulldozer	86	74	66	75	55	-	11
Sprayer	87	75	67	75	55	-	12
Generator	98	86	78	75	55	3	23
Impact Drill	87	75	67	75	55	-	8
Impact Piling	112	100	92	85	No Piling	7	-
Concrete Mixer	91	79	71	70	55	1	16
Concrete Pump	85	70	62	70	55	-	7
Pneumatic Hammer	84	86	78	75	55	3	23

Note: Distance between observer and machinery

From this it is clear that without exception night operations will exceed standards and day operations are uniformly excessive upto 20m. Only the noisiest operations produce excessive levels at 50m.

In the case of dust, excessive emission levels may also affect agricultural production, notably on Section 1.

6.2.11 Public Safety

Construction works on the scale envisaged for this project will pose a considerable threat to public safety. Specific threats will include:

- deep excavations
- the movement and operation of heavy equipment within the contract site
- movement of heavy equipment to and from the site
- stored materials, including fuel and other chemicals
- Modification to known road layouts.

There will, in addition, be the potential for the unauthorised use of the ARR ROW during the construction phase, particularly at night, for local access purposes.

Finally, there will also be a considerable risk to construction workers from all aspects of construction activities.

6.3 DEMOLITION

The Ministry of Supply stores and office complex on the Old Zarqa road are solid structures that may take considerable time and effort to demolish. During demolition the noise and dust emissions will be very significant. Similarly the site will be dangerous and measures will be required to minimise public access and threats to worker health and safety.

Finally the site will generate a substantial quantity of waste materials that will need to be disposed , or preferable reused.

6.4 USE OF EXPLOSIVES

It is possible that explosives will be used in the works required on Section 2 though this is by no means certain. The areas likely to be affected are largely uninhabited and in some areas already exposed to extensive use of explosives by the Quarry industry. Project impacts are therefore likely to be very limited.

Nevertheless, if explosives are to be used special measures for their storage protection and use will be required.

6.5 OFF SITE WORKS

6.5.1 General

This section deals with the off site works associated with the project, specifically, the construction camps to be established, and the raw material extraction and processing plants utilised.

6.5.2 Construction Camps

Four types of camp are expected[1];

(i) A Main Camp(s) serving as the operational centre of the project. This is assumed to comprise:

- offices; for administrative and technical personnel; 20 - 25 prefabricated offices, meeting rooms, stores, filing rooms etc.
- material and equipment storage areas.
- parking areas.
- equipment cleaning and maintenance yards.

No residential or dormitory facilities will be required.

(ii) Construction Yards: These will comprise,

[1] This section is to some extent abstract in that the number of off site facilities and their size and location will be as much a function of the number of contracts and number of contractors as specific operational needs.

- precast yard
- crushers
- asphalt plants
- cement batching plants

(ii) Satellite Camps: These are assumed to comprise equipment cleaning and material storage areas.

(iii) Temporary Camps; These may need to be established at specific sites along the proposed route, such as bridge crossings, where concentration of equipment and materials and will be required in the short term.

The establishment and operational use of these camps will have a number of adverse environmental impacts.

Water Use

The primary concern in this section is the consumption of water. At peak demand the Construction Yards will consume considerable quantities of water. Medium size batching plants producing say 400m^3 of concrete, would under require some 100m^3 of water. Multiple use of the same site would push consumption proportionately higher at that location. Total daily demands including the Main Camp may easily exceed 750m^3, the equivalent for a population of 3750 at 200 l/c/d.

Neither Temporary nor Satellite camps will require water substantial quantities of water.

Pollution

The major threat in this regard is pollution of both surface and groundwater resources from the industrial waste will be generated from the maintenance and cleaning of the construction equipment and from the Yards. Of particular concern is the disposal of wastewater from the cleaning of equipment since such water will contain pollutants. At a minimum, industrial strength detergents and oil cleaning solvents.

There will, in addition, be a potential risk of pollution from the accidental spillage of, and, or leakage from, industrial materials stored on site. The nature and significance of the threat to water resources cannot be determined at this stage, without full knowledge of the materials to be stored.

The major causes of pollution from the yards will be dust, noise and sediment load in wastewater.

Access and Construction Traffic

Access to and from the site will be of fundamental importance to the efficient implementation of the project. Easy access to a major existing road will therefore be a pre requisite for site location. All points of contact between the heavy construction traffic and existing traffic will be, potentially, significant accident spots. Three factors will contribute to this:

- the increased number of turning movements of heavy construction traffic gaining access to, and exiting from, the primary road

- the relatively low speed of the construction traffic

- the possibility of damage to the road surface from the increased level of heavy traffic and, more likely, modification of road surface conditions by mud, chippings, surface oil and other foreign matter.

Access to the construction sites, which may require the use of local access roads that would generally not be considered suitable for use by heavy vehicles will also be significant. Use by construction traffic of such roads may cause damage to the road surface or in other cases to structures, delays to non construction traffic and increased risk of accidents. This may be a particular problem in Wadi Ush and the sections south of the Muwaqqar Highway.

Satellite camps will be located within the project ROW or at sites designated for project facilities, e.g., maintenance camps or service areas. They will thus be serviced from within the ROW. The principal potential impacts will therefore be from access to and from the primary access routes. Temporary camps, by definition, will be located immediately adjacent to the ROW and will thus have no adverse impacts on existing traffic.

6.6 RESOURCE CONSUMPTION

6.6.1 Aggregates

Total estimates of the overall demand for aggregates, stone blocks for protective and other works are not available at this time. Nevertheless, it is considered that the impacts on the environment from raw material extraction, processing and transport for Section 2, ZEBP and the ZTR could be unusually limited. This assertion is based on the following assessment:

- a review of existing sources of aggregates, indicates that the development of new extraction sites will not be required. Moreover it is understood that the resources available at these sites will be sufficient to meet all likely demands in the immediate future.

- all existing facilities are, at present, carrying out the processes required to provide the necessary materials for the proposed project.

- the location of the existing extraction and processing sites is exceptionally favourable in relation to the proposed road alignment and hence construction sites. Required journey distances will be minimised.

- the primary routes for the transportation of aggregates will be the road alignment itself, project access roads, or lightly trafficked local roads.

- traffic can easily be routed to avoid significant settlements and should not unduly interfere with local traffic movements.

- the location of the extraction sites in relation to population centres is such that potential additional nuisance from noise and dust generated by potential increased output will be negligible

Section 1 is potentially the more problematic with aggregate sources may come from other areas.

If the Wadi Ush quarries are utilised particular care will need to be taken to ensure that an appropriate route is chosen that minimises the use of local access roads and passage through urban areas.

Option 1 is preferred if the alternative is additional HGV traffic on the Hizam road and Muwaqqar roads passing through urban areas and the extensive use of local access roads.

Overall the biggest threat is perceived to come from risk of an increase in road accidents. These accidents may stem from one of three causes:

- the increase in heavy vehicular traffic on certain sections of the existing primary network and some local roads.

- the associated increase in HGV turning movements, and the consequent further implications for the free flow of existing traffic

- foreign matter, in particular, mud and loose chippings being deposited on primary roads

6.6.2 Fill Material

The cut and fill budgets for the Project are not known but sufficient information is available to indicate that Section 1 will be the most problematic. It is however probable that borrow material is available throughout the area and that there are unlikely to be difficulties in their being accessed.

6.6.3 Water Consumption

In previous sections the requirements for water for consumption for off site facilities have been noted. To this must be added the demand for water in compaction of fill. Taking a general norm that the water requirement for compaction equates to approximately 10% by weight of fill, the following total demand calculations can be made.

$1m^3$ fill = 1600 kgs
Water requirement per m^3 = 160 kgs = 160 l

The final cut and fill budgets are as yet unavailable, however, available values for the Wadi Ush area an area of extensive earthworks suggests a requirement of around 100 000 m^3 per linear kilometre, or 100 m^3 per linear metre of road. Adopting 30% this value as representative of the project as a whole, gives a water requirement per linear metre in the order of $4.8m^3$.

(30 m^3 fill per linear m = 4800l per metre = $4.8m^3$)

Total project requirements for compaction, at 41 kilometres would therefore be in the order of 0.2 million m^3. Adding 10% for damping down/dust suppression gives a total demand of 0.22 million m^3. Split evenly over a four year project programme this gives a demand of 150m^3 per day.

The Wadi Ush data provides an indication of the likely peak daily demand, at 17.6m^3 per linear m (including damping down). Assuming operations on a 5000 m^3 of fill section per day, peak demand may exceed 850m^3 per day sufficient to broadly double overall project peak consumption.

SECTION 7:

IMPACT ASSESSMENT
PERMANENT IMPACTS

SECTION 7: IMPACT ASSESSMENT: PERMANENT IMPACTS

7.1 INTRODUCTION

This Section deals with the permanent impacts of the proposed project. In general terms these relate to the sterilisation of, and reduced efficiency of operations on productive lands, (Sections 7.2), take of non productive lands, residential and non residential property take, (Section 7.3), impacts on drainage patterns (Section 7.4) and severance, Section 7.5.

Where possible in the analysis of productive losses the impacts are expressed in monetary values. For these calculations the defined ROW is set at 60m. Associated works and works external to the ROW are excluded except where specified.

7.2 PRODUCTION LOSSES

Production losses will be confined to the sterilisation three basic impacts on productive activities in the region:

- Sterilisation of productive lands
- Interference with, or modification of, management practices
- Destruction of farm infrastructure

Each of the two types of productive agricultural land listed below will be affected differently by the proposed road. Accordingly each is addressed in an independent section.

- Rainfed Arable Land
- Permanently cropped land (tree crops)

7.2.1 Rainfed Arable Lands

Between 11.65 and 12.02 linear kilometres of road traverses rainfed arable lands depending on the southern option selected. The split is detailed in Table 7.1.

Table 7.1 Rainfed Arable Land Take

	MR	Area (Hect)	RR	Area (Hect)
Option	58.97%	41.20	60.23%	43.44
Section 1	40.09%	28.02	38.85%	28.02
Section 2	-	-	-	-
ZTR	0.94%	0.6	0.92%	0.60
ZEBP	-	-	-	-
Total	100	69.82	100	72.06

Source: Consultants Estimates

It is likely that the area of land foreclosed by the project ROW will be greater than the actual land take, with some land withdrawn from production because of access difficulties. In the most cases this factor will be relatively small, and therefore for analytical purposes a nominal value of 5 % of arable land take has been applied. Land take, external to the ROW will be by no means insignificant but can not be estimated at this time. For calculation purposes however a nominal loss of 50 dunums of productive arable land is assumed.

Taken together an overall loss of some 80.6 hectares (Red Route) is estimated to be lost to production. Using data provided by the Department of Agriculture on the farming systems of the region, crop yields and market prices[1], the monetary value of lost annual production to rainfed arable farmers is estimated to be in the order of JD 36,875, (although this will vary substantially with the quality of the rains).

Taken over the twenty years of the evaluation period, the impact of the project, expressed in terms of lost production value, would amount to an NPV of some JD 174,000 discounted at 12 %, (Table 7.2). At constant prices this equates to some JD 0.5 million.

Table 7.2 Estimated Rainfed Arable Crop Losses

Year	Prod Losses	Cons Dam	Total
-3	22487.4	224.9	22712.3
-2	22487.4	224.9	22712.3
-1	22487.4	224.9	22712.3
1 -20	22487.4	0.00	224874.4
20 Yr. Losses			**JDs**
NPV at 12 %			174100
At Constant Prices			518,000

Source: Consultants Estimates

To these costs must be added an indicative cost to represent losses in areas adjacent to the Highway during the construction phase. Such losses will result from accidental damage and dust, see Section 7. This has been set arbitrarily at 1% of annual lost production, for each of the assumed construction years, equivalent to JD 225 per annum.

It should be reiterated here, that the calculations contained in this, and following, sections are not based on inventory surveys of the actual farmlands affected and the actual production levels achieved on these lands. They are based on available published data and site visits and have been generated for an "average" hectare of each type of farmland impacted. They are intended only to provide order of magnitude estimates of the potential production losses.

The figures above, however, represent only the loss of productive land. To estimate the full impact of the project and hence an indication of compensation costs it is necessary to indicate the number of farmers impacted and the likely significance of that impact on the viability of the land holding. Such data is as yet unavailable but will become available with the results of the ongoing Project Census.

Management Operations

In addition to the actual losses of productive land costs will be incurred by the project through increased farm operation costs caused by the severance effect of the Highway. These costs would, in most cases be restricted to the larger, mechanised farms, and would be related, primarily, to the additional time and VO costs incurred. Smaller farms of less than 10 hectares are unlikely to be have their management operations badly affected by severance, since in cases where strong severance effects are incurred the viability of the holding may be placed in

[1] For field crops Barley (which is by far the dominant crop) is utilised and the returns estimated include the crop yield and assumed values as fodder (residue/stubble) for livestock

question and therefore field consolidation may be required, and losses to sanitisation would be expected.

7.2.2 Permanent Crops

The minimum take of Permanent Crops in the defined ROW is detailed in Table 7.3 as follows:

Table 7.3 Perennial Crop Area (Hectares) and Tree Take

	Olive: Irrigated		Olive: Non Irrigated		Pine:[2] Non Irrigated	
	Area	Trees	Area	Trees	Area	Trees
MR	1.075	430	0.750	300	0.128	80
RR	0.325	130	-	-	0.032*	20
Section 1	0.350	140	-	-	-	-
Section 2	0.850	340	9.450	3780	-	-
ZEBP	-	-	-	-	-	-
ZTR	-	-	-	-	-	-
Total (RR Option)	1.525	610	9.450	3780	0.032	2.0

Note * Area is part of olive grove
Source: Consultants Estimates

The yields estimated for each crop are as outlined in Table 7.3.Clearly these are approximate values in that they assume constant yields before throughout productive life and for the purposes of this study are taken at peak production.

On the basis of the data outlined in Appendix H, the annual production losses attributable to the project are estimated in Table 7.4 at JD 146,400 equivalent to an NPV of JD 1,13 million at 12% DR and JD 3.37 million at constant prices.

Table 7.4 Estimated Permanent Crop Losses

Year	Prod Losses	Cons Dam	Total
-3	146416	1464	147880
-2	146416	1464	147880
-1	146416	1464	147880
1 -20	146416	-	146416
20 Yr. Losses			**JDs**
NPV at 12 %			1,133,600
At Constant Prices			3,372,000

Source: Consultants Estimates

These estimates assume all trees/vines are productive. Therefore the production losses may be slightly exaggerated, in not allowing for declining production with age, loss of production due to replacement etc.

[2] The pines in question form part of the landscaping / shelter belt planting for the Desert Highway and are not assumed to have a product value. They are therefore excluded from further analysis

7.2.3 Vegetables

Vegetable production is confined to two areas; courgette farms on the RR near the Desert Highway and a small irrigated patch of some 1.28 hectares on the ZTR. Estimated losses are consequently quite small at less than JD 26,000 per annum as indicated in Table 7.5.

Table 7.5 Estimated Vegetable Losses

Year	Prod Losses	Cons Dam	Total
-3	25689	257	25946
-2	25689	257	25946
-1	25689	257	25946
1 -20	25689		25689
20 Yr. Losses			**JDs**
NPV at 12 %			198,900
At Constant Prices			592,000

Source: Consultants Estimates

7.2.4 Total Production Losses

The calculations above suggest that the total costs to the project from the take of productive lands, expressed in NPV terms at a 12% DR, will be in the order of JDs 1.5 million and over 4.4 million at constant prices, Table 7.6.

These losses are not particularly high and reflect only lost production costs. Wider, less tangible social costs are not estimated.

Table 7.6 Total Production Losses to Agricultural Sector

Year	Prod Losses	Cons Dam	Total
-3	194594	1946	196540
-2	194594	1946	196540
-1	194594	1946	196540
1-20	194594	0	194594
20 Year Losses			JD
NPV at 12% DR			1,506,600
At Constant Prices			4,481,500

7.3 LAND ACQUISITION AND PROPERTY TAKE

7.3.1 Rangelands / Non Productive Lands

The previous section identified some hectares of productive land take. Some 207 hectares of lands to be acquired are unaccounted for. Those related to properties are addressed below and account for a further 0.4 hectares.

The remaining lands are utilised for grazing on a regular or more occasional basis. Further differentiation of such lands into tenure and specific use categories is not possible at present.

7.3.2 Residential Units

The project is estimated to require the acquisition of 3 villas and 5 apartment units and 4 houses. In total therefore less than 20 households are expected to be require resettlement as indicated in Table 7.7.

Table 7.7 Residential Building Take

Type	Villa	Apartments	House	Other
MR	-	-	-	-
RR	-	-	-	-
Section 1	-	-	2	-
Section 2	-	-	2	-
ZTR	3	5*	-	-
ZEBP	-	-	-	-
Total	3	5	4	0

Note * In two structures of 3 and 2 Apartments respectively

7.3.2 Non Residential Buildings

As would be expected, because of the largely rural nature of the highway, the building take is relatively low. Using the draft preliminary design available it is estimated that a total of some 25-30 structures will fall within the ROW. The nature of these structures varies widely from greenhouses, individual farm stores and guard houses to the entire Ministry of Supply Grain Store complex. A final census of property take will be required during the final design phase.

A summary of the buildings to be demolished is given in Table 7.8 by road section.

Table 7.8 Non Residential Building Take

Type	Greenhouse (units)	Wells (units)	Walls (lin. m)	Farm Structures (units)	Guard-houses (units)	Other
MR	5	-	1680	-	1	-
RR	-	-	740	-	-	1 pumping station
Section 1	-	-	350	-	-	-
Section 2	-	-	1480	-	-	-
ZEBP	-	-	-	-	-	-
ZTR	-	-	1240	-	-	5 Stores 2 Office buildings
Total	5	-	5490	-	1	5/2

7.4 DRAINAGE AND EROSION

7.4.1 Section 1

Section 1 is a largely flat low energy environment. However, where r extremely vulnerable to erosion once the ground cover is removed or rills are established.

The main Wadi Ush is a major concern between stations km18+250 and 20+750. The project alignment in this area will require either:

- Local drainage works

From the available design documentation it is difficult to determine the extent of the drainage works required though it is probable that there would be a required for sealed box culverts running underneath and along the road alignment.

- rechannelling of the wadi

This option appears difficult. There is little room within the existing valley for both the Wadi and the road unless it is effectively reconstructed as a purpose built channel with road and wadi physically separated. The topography dictates that any rechannelling outside the main course would be extremely difficult and to the west. In this case it is almost inconceivable that re-routing the road would not be a preferable and far cheaper alternative.

None of the above options is desirable and all are potentially expensive. There will also be some risk that the hydrological parameters utilised are inadequate and the engineering solution does not work as intended. While such an event would be unlikely it is by no means impossible.

Though a failure of the engineering would be extremely unlikely to cause catastrophic damage beyond the road either laterally or downstream damage to the project would be severe.

There is one further complicating element in this site the illegal dam built downstream near kilometre 20 +250, by a plot owner. At this time the alignment would require its demolition and this would resolve potential technical concerns. However, should the road be realigned in that section the potential impact of works on Wadi Ush upstream of the dam on the dam must considered.

Along the **side wadis of Wadi Ush** three areas of concern are raised:

(i) Where the profile is on fill the topography is such that water will be retained behind the structure and ponded. This may inadvertently create water holes for sheep that lead to occasional concentration and damage to the environment and, or damage to the embankment.

Sufficient cross drainage will therefore be required to eliminate the possibility of significant ponding.

Similarly, care must be take to ensure that discharge flows of the cross drainage are not erosive.

(ii) Where the profile is in cut the internal drainage system should be designed to ensure that excessive lengths of drainage are not collected and discharged at excessive speed.

(iii) The collection and discharge of run off in these areas may affect the cultural and archaeology resources of the region. Care will need to be taken therefore to ensure such sites are identified and accommodated in the drainage design development.

7.5 SEVERANCE

Severance in this instance is defined in one of three ways:

- Severance of existing communications links in the area of influence of the project
- Severance of rural communities
- Severance of Individual Properties

7.5.1 Severance of Existing Communications Links

Severance here is as the modification of existing pedestrian vehicular and other circulation within the study area. The temporary impacts of the construction phase in this regard have already been reviewed.

There are three elements to this impact.

(i) The closing or re routing of an existing vehicular link

There are a number of small settlements at present linked by a local area access network that may be altered by the Project. For evaluation purposes these are in grouped into the three 'catchments' shown in Figure 7.1.

Catchment 1 is served by a single carriageway surfaced road running alongside the wadi and passing through the industrial area. This road may[3] be severed as indicated on Figure 7.1 and no immediately obvious alternative alignment is available.

The area contains at its southernmost extremity is a chemical plant that is entirely dependent on this road for access to the network. Other sites that could be isolated include:

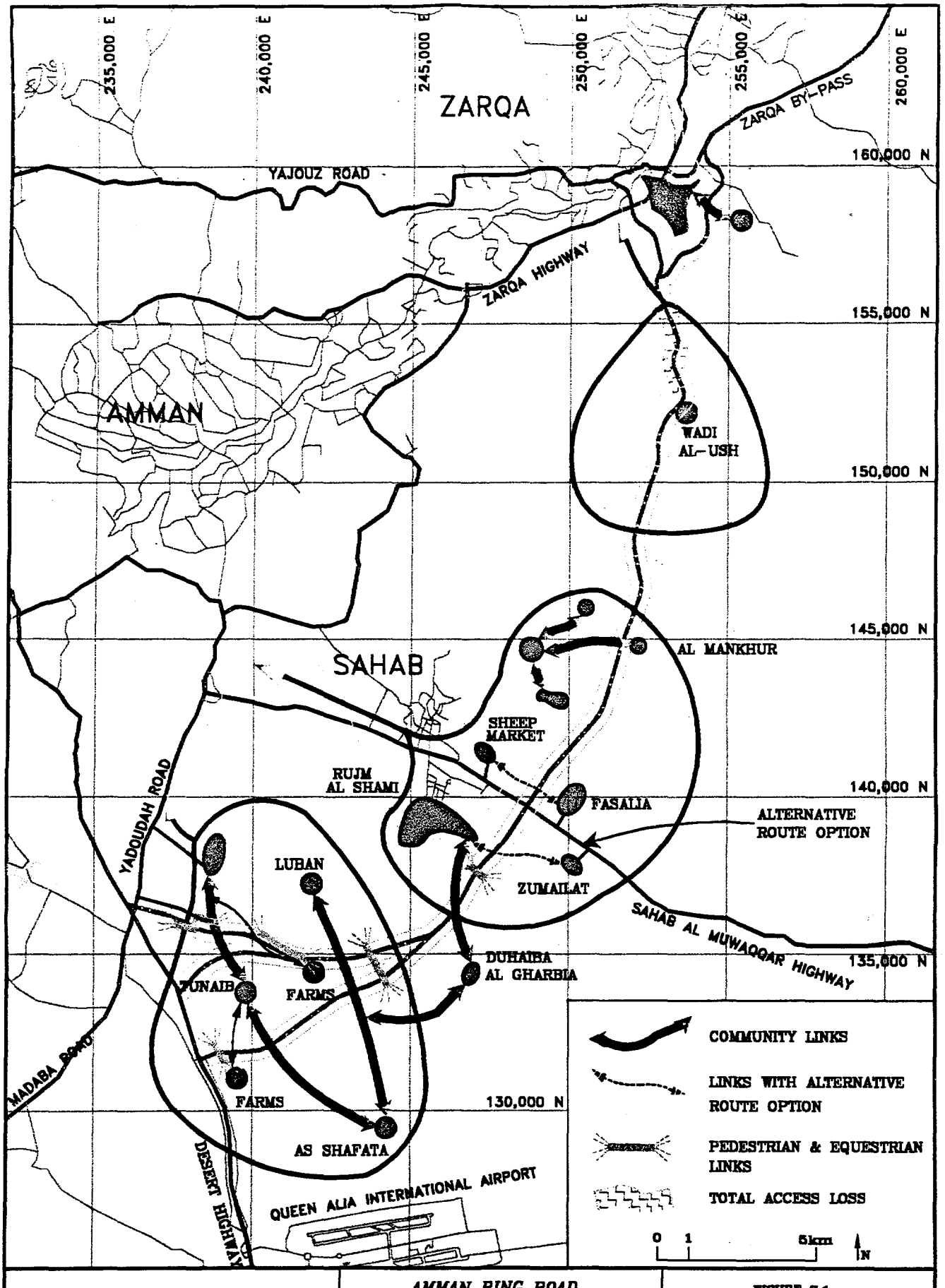
- a chicken farm
- a small community of some 10 -20 houses
- a number of individual houses (2 of which will be acquired if the alignment remains on its present centreline).

(ii) the closing or rerouting of an existing pedestrian link

(iii) the closing or rerouting of known animal husbandry trails.

The severance impacts relating to the management and operation of productive land units has already been addressed above.

[3] Given the relative proximity of the ARR, the existing road and the wadi channel in this area and the relative difficulty of the terrain it is not possible to define prior to the completion of the final design whether this access road will in fact be completely severed.



AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 7.1

REGIONAL ACCESS LINKS

Catchment 2 is served by two surfaced roads that lead to Sahab from areas North and South of the Muwaqqar highway and the Muwaqqar Highway itself.

The route from Al Manakhir to Kashafia is not heavily trafficked but provides good all weather all vehicle access for the community to Sahab and via Sahab to Amman. Alternative routes to the south (to Muwaqqar Highway) are clearly of a much lower standard and would represent a major loss of amenity. Upgrading existing tracks to the south would be expensive (8- 10 kilometres through difficult terrain) and would severely disrupt links with the communities at Kashafia and Al Faraj.

The sheep market located on Figure 7.1 is a source of considerable animal movement from the village of Faisaliyah in particular but also from other centres to the east of the ARR. Maintenance of the direct route from Faisaliyah while not essential will keep significant animal movements (vehicular and pedestrian) away from the Muwaqqar Highway and in particular the proposed interchange which in conjunction with the cemeteries form a considerable barrier to cross movement in the area.

The village of Dheybah is cut off from Sahab, and the Muwaqqar highway, probably the heaviest trafficked movement in the catchment. A lesser movement from Dheybah to west north west to Luban is also severed. Both movements will need to be re-established though a rationalised alternative local network may be considered if necessary.

Catchment 3 is the most complex in terms of the density of linkages but is nevertheless straightforward in requiring primarily the maintenance of north - south links. Only one lateral movement is affected and even then only with the northernmost option.

(ii) The closing or re-routing of an existing pedestrian link

Pedestrian access is an often under estimated element of Highway design which has serious consequences that are usually reflected in an increase in the rate of accidents. Although this project is predominantly inter urban and will thus require relatively few pedestrian crossing points there will be specific requirements in three areas:

(i) Zarqa: Where the profile of the ZTR is such that pedestrian movement will be adversely affected in two areas:

- Within the Residential area

The profile of the ZTR beyond the interchange to the north is such that complete severance of the area can be expected without special provision. Preliminary engineering drawings available indicate that it is proposed to relocate the existing local road to a new Bridge some 50m to the south. Specific provision for pedestrians at this location would provide sufficient cross access.

- Interchanges

There is not much pedestrian movement in the immediate vicinity of the proposed Zarqa interchange at present although the industrial area junction is a well used pick up and set down point for public traffic. In the future it is probable that such activity will migrate to the

proposed interchange generating significant pedestrian movement and, if unmanaged, some deterioration in road operational performance.

Similar problems would be expected at the Yajouz Interchange though here the retention of existing movement along Yajouz Road should minimise impacts to the existing circulation.

(ii) Other Interchanges

Potentially the biggest concern will be the Desert Highway interchange. This is proposed to be a relatively high speed, free flow semi directional interchange. While this will aid traffic and limit the potential for vehicle only accidents there is also a serious risk that that the interchange will be used as pick up and set down point. Such practice will be extremely dangerous.

Vehicles can not be permitted to stop (except in an emergency) on any element of these interchanges at grade or on ramps. Similarly, passengers may not be dropped off and left to wander in the reserve or sprint across high speed free flow road lanes.

(iii) The closing or re-routing of known animal husbandry trails.

Livestock are an integral part of the farming systems of the region and the three Governorates of the Project area are estimated to contain over 350,000 animals of various kinds. Movement of these animals will take many forms including:

- movement to market
- to new feeding grounds
- to watering points
- grazing

In each case the denial of access and even the provision of mitigating access points may have considerable impact. This may take many forms including:

(i) Vandalism of protective fences and forced entry to the Highway with danger to livestock, herder and vehicle operators. Introduction of mud etc. onto the carriageway will also pose some hazard.

(ii) Concentration of animals around limited access points will exceed carrying capacity of land and destroy vegetation cover. Similarly concentration of hoofs may cause serious damage to top soil and initiate erosion.

(iii) Initiation of communal disturbances over access routes to the crossing points and grazing and water rights.

(iv) Damage to embankments. Animals scrambling up embankments cause substantial damage to surface vegetation (if present) or the compacted material if not. In a very short period this damage may be translated into rilling and erosion leading quickly to serious damage. Such damage will continue to occur even after repeated repair / maintenance unless a crossing point is provided.

In addition, the presence of such large numbers of livestock will place extraordinary demands on those responsible for the maintenance of the protective fences along the entire length of the Highway if accidental entry to the road by animals is not to occur. This may require establishment of a specific maintenance procedure and long term monitoring of the efficacy of various fencing materials available.

Finally, it should also be noted that the physical impact of the road in these areas will be enormous. Existing lifestyles and activity patterns may be irrevocably damaged and ongoing processes of cultural and economic change accelerated.

7.5.2 Severance of Rural Communities

No rural community is physically cut by the ARR. There is therefore no circumstance in which the links between two halves of a community need to be re-established. However, it is clear that there are a number of dispersed houses and activities in the vicinity of the Desert Highway on the northern, MR that are linked and which will be adversely affected by that alignment.

7.5.3 Severance of Individual Properties

No property other than those in Wadi Ush has its access to the public road network severed. The Military area at the northern end of the ZEBP will have its access to the existing road severed. This access will clearly have to be restored though there is as yet no confirmation that the Military authorities will remain on the site for and after project construction.

SECTION 8:

IMPACT ASSESSMENT
OPERATIONAL PHASE

SECTION 8: IMPACT ASSESSMENT: OPERATIONAL PHASE

8.1 INTRODUCTION

This section chapter deals with the potential, traffic related, environmental impacts of the proposed project under eight broad headings:

- Traffic Noise
- Vibration
- Local Traffic Systems
- Air Quality
- Energy Budget
- Safety
- Water and Soil Pollution
- Maintenance

This Section also contains an overview of the opportunities available for the environmental enhancement. The following Section 8.2 provides a summary of the Traffic forecasts utilised in the assessment carried out in much of this chapter. A detailed review is provided in Appendix I.

8.2 TRAFFIC FORECASTS

The traffic data utilised for all traffic related assessments including the noise assessment was derived from the model developed for the feasibility study. The basic data utilised is provided below in Table 8.1.

8.3 NOISE

8.3.1 Approach

Discussions with GCEP and other concerned agencies have confirmed that no definitive methodology has been established for the estimation of noise benefits and disbenefits related to road (or other) projects.

The ARR is a regional road that is anticipated to have a number of benefits within Amman in reducing congestion, adjusting the traffic mix on principal routes etc. However these are virtually impossible to quantify at this time. This analysis is therefore confined to assessing:

(i) the potential effects of the Project as reflected by its projected impact on representative sections of the existing 'ring road':

- Desert Highway
- Yadoudah Road
- Sahab Road
- Hizam Road
- Zarqa Highway

Table 8.1 24 hour and Peak Hour Weekday Traffic Flows on Road Sections: Without Project Case

Road Segment	Traffic Flow Data				Average Speed (Km/h)	Year
	veh/h	%HDVs	LDVs	HDVs		
Sahab Al-Muwaqqar	96	30.0	67	29	65	
Desert Highway	1256	25.0	942	314	95	
Yadoudah road (Hotel)	1392	30.0	974	418	77	1
Yadoudah road	1861	26.0	1377	484	67	9
Sahab road	906	30.0	634	272	43	9
Hizam road	1830	40.0	1098	732	58	7
Zarqa Highway West	1769	40.0	1061	708	53	
Zarqa Highway East	1768	40.0	1061	707	53	
Yajouz Road	800	35.0	520	280	43	
Old Zarqa Road(M)	1047	30.0	733	314	33	
Sahab Al-Muwaqqar	213	50.8	105	108	65	
Desert Highway	2160	25.1	1618	542	95	
Yadoudah road (Hotel)	2109	26.8	1544	565	76	2
Yadoudah road	2754	30.4	1916	838	60	0
Sahab road	1409	31.7	963	446	33	0
Hizam road	1298	42.6	745	553	58	3
Zarqa Highway West	2385	40.0	1432	953	53	
Zarqa Highway East	2384	40.0	1431	953	53	
Yajouz Road	1064	20.5	846	218	47	
Old Zarqa Road(M)	1342	16.8	1117	225	33	
Sahab Al-Muwaqqar	280	50.6	139	142	65	
Desert Highway	3421	23.0	2634	787	81	
Yadoudah road (Hotel)	3284	25.3	2454	830	63	2
Yadoudah road	4180	28.9	2974	1206	48	0
Sahab road	2352	35.2	1525	827	31	0
Hizam road	2416	40.2	1445	971	54	8
Zarqa Highway West	3565	37.4	2232	1333	53	
Zarqa Highway East	3564	37.4	2231	1333	53	
Yajouz Road	1557	22.8	1202	355	43	
Old Zarqa Road(M)	1814	17.3	1500	315	33	

Do Something Effective Traffic Flows

Road Segment	Traffic Flow Data				Average Speed (Km/h)	Year
	veh/h	%HDVs	LDVs	HDVs		
Sahab Al-Muwaqqar	221	49.6	111	109	65	
Desert Highway	2012	22.0	1570	442	95	
Yadoudah road (Hotel)	2037	21.8	1593	444	77	
Yadoudah road	2767	27.2	2014	753	61	
Sahab road	1280	31.4	878	402	33	2
Hizam road	954	42.3	550	404	58	0
Zarqa Highway West	2558	33.0	1714	844	53	0
Zarqa Highway East	2435	35.6	1568	867	53	3
Yajouz Road	1289	21.4	1013	276	43	
Old Zarqa Road(M)	1394	16.4	1165	229	33	
ARR (Z.C.)	2558	33.0	1714	844	53	
Ramp 6 (Z.C.)	362	26.6	266	96	60	
Loop 3 (Z.C.)	94	68.7	30	65	45	
ARR (H.,C.)	333	47.1	176	157	95	
Ramp 1 (E.C.)	10	53.7	5	5	60	
Loop 1 (E.C.)	209	45.1	115	94	40	
ARR (M)	1411	23.6	1078	333	65	
Sahab Al-Muwaqqar	293	50.0	146	146	65	
Desert Highway	3296	21.1	2601	695	95	
Yadoudah road (Hotel)	3079	22.8	2376	703	65	
Yadoudah road	3679	26.5	2704	975	52	
Sahab road	2009	33.2	1342	667	33	2
Hizam road	1592	37.1	1001	591	58	0
Zarqa Highway West	3913	28.3	2805	1108	53	0
Zarqa Highway East	3232	34.8	2108	1124	53	8
Yajouz Road	1827	21.9	1427	400	43	
Old Zarqa Road(M)	1668	18.4	1360	308	33	
ARR (Z.C.)	3913	28.3	2805	1108	53	
Ramp 6 (Z.C.)	498	26.1	368	130	60	
Loop 3 (Z.C.)	138	67.8	44	94	45	
ARR (H.,C.)	658	41.0	388	270	95	
Ramp 1 (E.C.)	15	48.1	8	7	60	
Loop 1 (E.C.)	315	44.4	176	140	40	
ARR (M)	2497	20.0	1998	499	65	

RSS and the MPWH have confirmed that there are no available measurements of traffic noise on the existing Zarqa Highway, Hizam Road and Desert Highway or any other relevant and comparable road. Therefore base year forecasts are estimated using the predictive model and are not calibrated to observed data.

(ii) The effect of the Project at sites along its alignment in both rural and urban cases.

(iii) Impacts on Sensitive Sites

Data from the generalised land use survey conducted in May 1998 indicates that there are six sensitive sites within the corridor that could be classified as vulnerable and. These are:

- The Al Usra University (Desert Highway)
- A Hotel (Yadoudah Road)
- East and West Cemeteries at the Sahab Interchange
- Zarqa College
- Zarqa Mosque
- Zarqa Schools

In the absence of an "approved" methodology an approach utilised in the UK for use in Public Consultation exercises and relating to inter urban roads has been adopted. In general terms this approach seeks to define the numbers of individuals likely to experience an increase or decrease in noise level exposure by estimation of the number of dwelling units that may be affected. The analysis required for this exercise includes:

- estimation of noise levels on existing and proposed routes in the base year.
- estimation of maximum traffic flow on a normal working day for both, the proposed road and existing roads in, with and without, project cases
- estimation of traffic speeds
- definition of the anticipated change in noise level.

In all cases, two years are estimated, the year of opening 2003, and 2008. Forecasts beyond that period are projected in the economic forecasts but will have little meaning in the peripheral urban development context of the project.

8.3.2 Existing Ring Road

Forecast noise levels on the existing ring road in with and without project cases are shown in Table 8.2.

Table 8.2 With and Without Project Case Noise Estimates L10(18 Hr): Existing Ring Road

		1997	2003
Desert Highway	With		77.34
	Without	76.07	77.97
Yadoudah Road	With		75.05
	Without	75.26	76.67
Sahab Road	With		67.07
	Without	62.83[1]	67.99
Hizam Road	With		74.95
	Without	74.32	75.46
Zarqa Highway	With		76.70
	Without	76.90	77.05
Zarqa By Pass	With		74.15
	Without	75.49	75.66

[1] These values are artificially low. Traffic levels at the time of survey were deflated by upgrading works.

8.3.3 ARR

(i) Rural Area

Some 82 properties lie within a 300m band either side of the ROW of the ARR (including both options in the south). The minimum, maximum and average projected noise levels noise level along the rural elements of Section 1are as shown in Table 8.3.

Table 8.3 Noise Impact On Previously Unaffected Rural Area: 2003 and 2013

Distance From CL	No. of Sites	L10 (18 Hr)			L10 (Peak)		
		Min. dB(A)	Average dB(A)	Max. dB(A)	Min. dB(A)	Average dB(A)	Max. dB(A)
0-50	8	63.42	66.34	68.81	65.77	68.70	71.16
51-100	15	55.76	59.89	62.34	57.90	62.21	64.70
101-200	31	53.25	57.62	61.06	55.38	59.97	63.42
201-300	28	49.34	54.40	58.38	51.48	56.75	60.73

Note: Assumed Ambient Noise: 45 dB(A)

Under the UK guidelines for compensation outlined below only two properties would qualify.

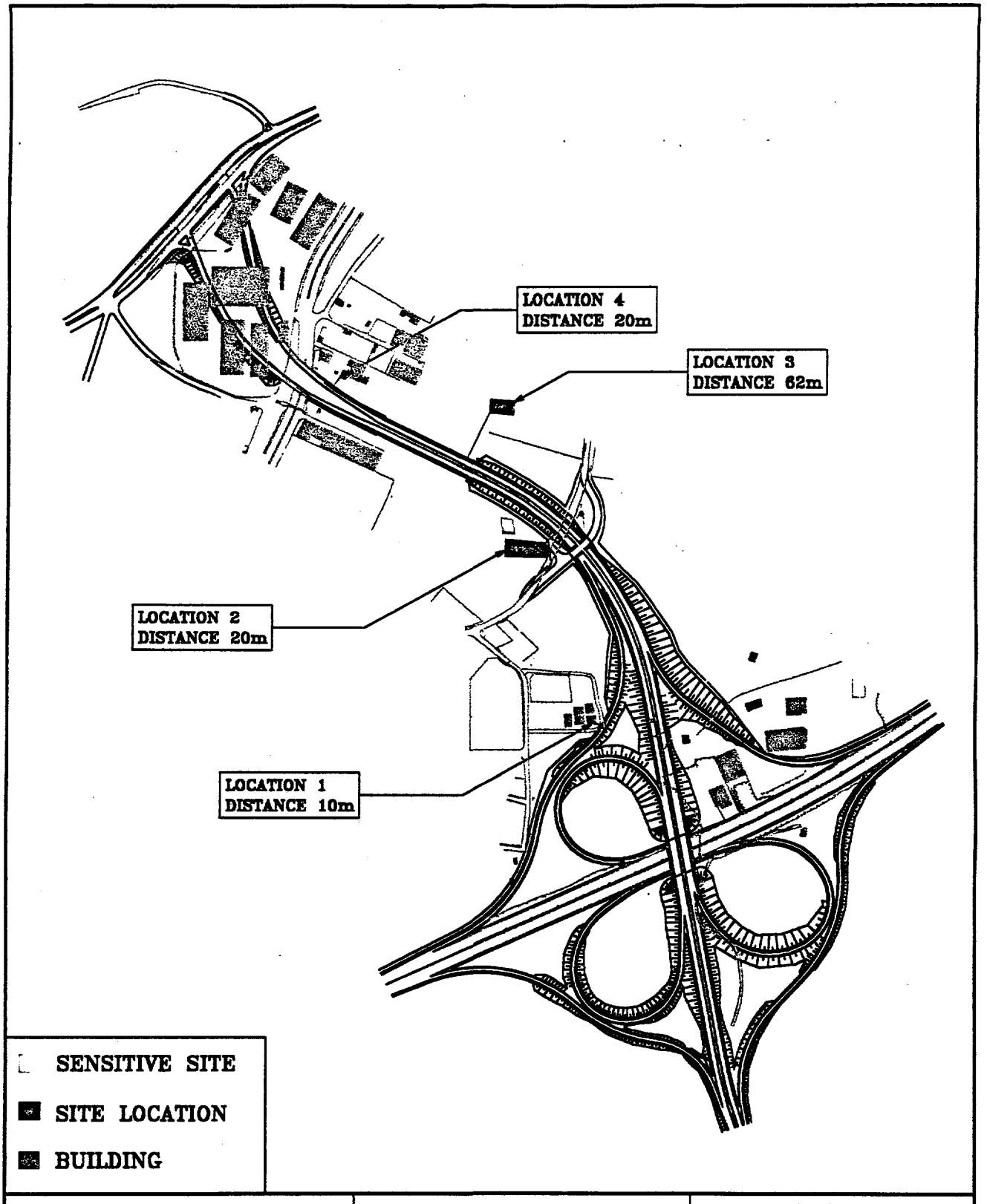
- > 68 dB(A) L10 (18 hr)
- Noise Level > 1 dB(A) more than before
- New Road / Altered Highway > 1 dB(A)

Nevertheless, the changes in noise levels in the vicinity of the ARR will clearly have considerable nuisance value to the affected populations. Evidence is available from a number of surveys carried out in the UK on the correlation between traffic flows and public dissatisfaction. The general conclusion of these surveys is that most people are able to distinguish a change of 1 dBA in a pure and continuous sound but changes in the average level of fluctuating sound, such as traffic noise are not so readily perceived. The survey of national exposure to traffic noise did not identify general dissatisfaction with traffic noise until L10 levels were at least 3 dBA apart. However, it should be noted that these studies relate to long term dissatisfaction, to noise levels that people have become accustomed, and that short term changes in noise levels of less than 3 dBA were distinguished. In general terms the 3 dBA level equates to a halving or doubling of traffic loads.

On the basis of this research, it is clear that all residential properties within the 300m band either side of centreline will suffer significant disamenity, assuming ambient noise levels of < 55 dB(A).

(ii) Noise Impact On Urban Area (Figure 8.1).

Four urban sites have been selected to represent the worst case noise disamenity along the various frontages of the ZTR (defined as the only urban environment) as indicated in Table 8.4.



BAB AL-HANDASAH — BAB AL-HANDASAH	*AMMAN RING ROAD* *ENVIRONMENTAL IMPACT ASSESSMENT*	*FIGURE 8.1* *URBAN AND SENSITIVE SITES*

Table 8.4 2003 Do Something Project Impacts Urban Sites Within 300m of the Centreline

Location	Minimum Distance (m)	L10 (18 hr) dB(A)	L10 (Peak) dB(A)
1	10	68.41	70.77
2	20	60.37	62.72
3	62	56.35	58.70
4	20	66.53	68.89

(iii) Impact on Sensitive Sites (Figure 8.2)

As Table 8.5 indicates, adoption of the UK compensation criteria only 1 structure, the Mosque qualifies for compensation, under the do something case. However, the cemeteries and in particular the West Cemetery would also appear to warrant further attention.

Table 8.5 Do Something Project Impacts: At Directly Affected Sensitive Sites, 2003

Reduction >1 dB(A)	Neutral (0-1) dB(A) Change	Increase >1 dB(A)
-	Hotel (-0.62)	East Cemetery (+9.15)
-	Zarqa College (-0.12)	West Cemetery (+15.96)
-	Zarqa School 1 (+0.79)	Mosque (+6.42)
-	Zarqa School 2 (+0.78)	-
-	Univ. Building (-0.62)	-

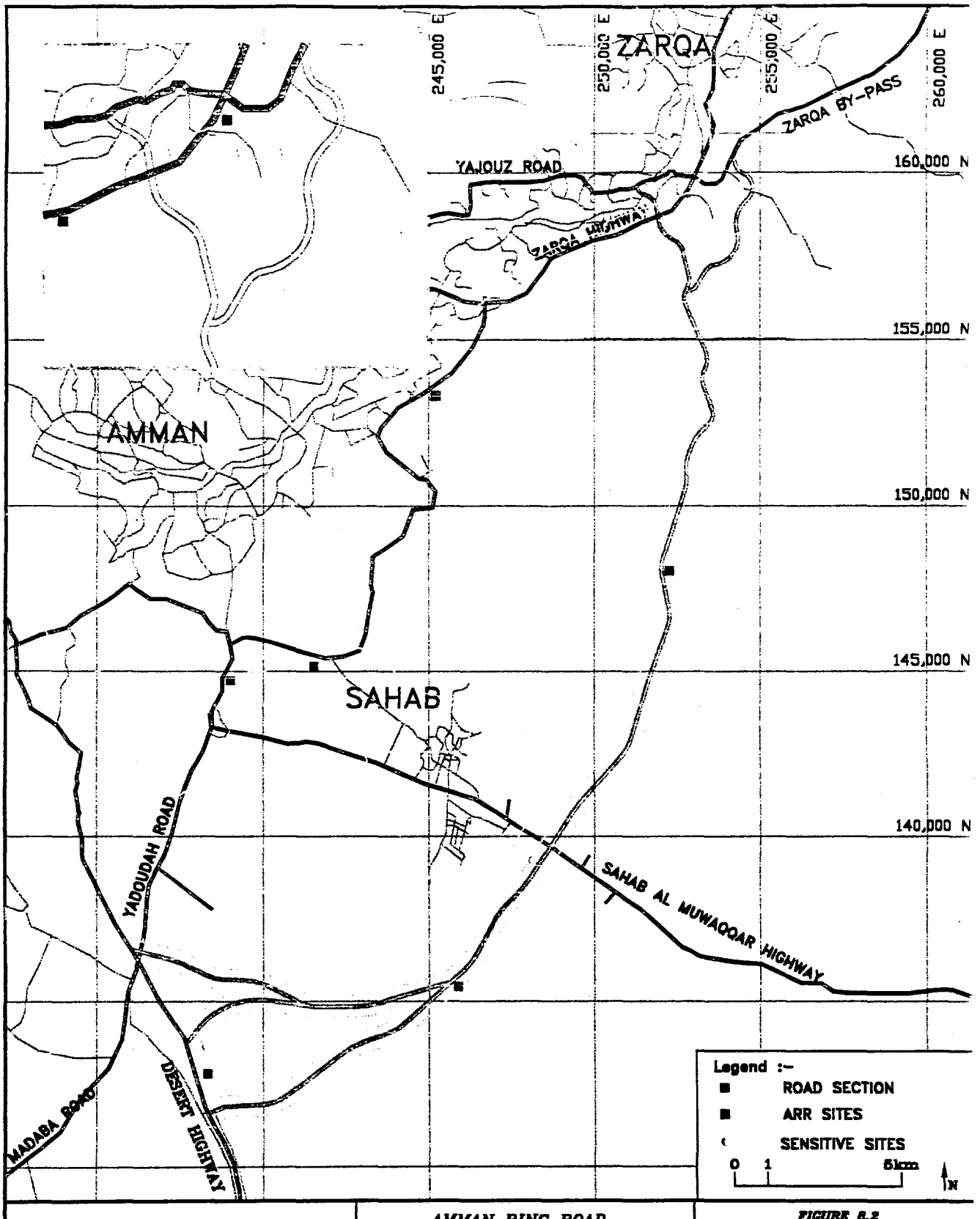
8.4 VIBRATION

Traffic vibration is a low frequency disturbance producing physical movement in both buildings and their occupants that can be transmitted through the air or the ground.

The frequency of air borne vibration from traffic is typically below 200 Hertz with the dominant frequencies in the 50 -100 Hz. range. Ground borne vibration, produced by the interaction between rolling wheels and the road surface is typically in a lower, 8-20 Hz range.

8.4.1 Buildings

A considerable body of research has been undertaken in the UK on the effects of **vibration** on buildings (TRRL and Watts 1990) with the conclusion that there is little evidence to support the contention that traffic induced vibrations are a source of significant damage to buildings. Minor cracking of plaster was found to occur at high exposure sites, (heavily trafficked roads with poor surfaces and subgrade conditions) but it has not been possible to isolate traffic as the single causative factor. Given the relationship between vibration effects and poor road surface conditions, conditions not considered to apply to this project, the inability to isolate vibration as a primary factor in building deterioration and given that no historic or archaeology site with surficial structures likely to be adversely affected by vibration was identified, the effects of vibration on buildings were not considered further.



DAR AL-HANDASAH DAR AL-HANDASAH

AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 6.2

SECTION NOISE ASSESSMENT SITES

8.4.2 Occupants

Occupants may be affected by ground borne vibration even if the structure they are within remains unaffected. Generally this will occur with older roads with soft subgrades or uneven surfaces. In the case of new roads impacts are rarely felt unless the dwellings are within a few metres of the roadway. Accordingly ground borne is not expected to be a factor in this project.

Air borne vibration originating from the sounds emitted by vehicle engines and exhausts is a frequent cause of annoyance to people in proximity to the roadway. Studies in the UK by Baughan and Martin (1981) and Watts (1984) suggest that for any given increase in traffic noise there is on average an almost identical increase in vibration. In addition they conclude that the increase in the percentage of people bothered by increased traffic noise is almost identical to that for increases in vibration.

In accepting these findings the UK Department of Transport recommend that assessments of the impact of increased vibration are assessed using the same indicators utilised for noise evaluation, in this case LA10, 18 Hour. In the absence of any other standards the analysis in this study will adopt the same approach.

Vibration impacts are therefore assumed to be identical to those from Noise and are thus equally limited.

8.5 AIR QUALITY

8.5.1 General

This section deals with the pollutants that are generated by vehicular traffic and which are transmitted in the air. Though vehicular air pollution is not yet a major health issue in Amman it is of concern to this report for three reasons.

(i) it is an issue of some concern to residents of the Region as reflected in the findings of the Project scoping exercise.

(ii) the NES concluded that the 'Main Issues According to Priority' in this context are as follows;

- Zarqa Basin: including: Hashimiya: Three major sources, Jordan Petroleum Refinery, Hussein Thermal Power Station, and the Khirbet Samra Wastewater Treatment Plant generate SO_2, H_2S, CO Hydrocarbons, TSP and NOx.
- Zarqa Urban Area: Affected primarily by pollution from urban and peri urban industrial facilities, and traffic.
- Natural Dust storms.

(iii) there are potential benefits to the project from the reduction in traffic generated pollution in downtown Amman where the effects of emissions are exacerbated by the topography which prevents dispersion of pollutants. Relatively high levels of TSP, SO_2, CO and NOx are experienced.

In specific terms the issue of air quality needs to be assessed only if it can be shown that there is an:

a) overall increase or decrease in vehicular traffic flows and hence emissions in the area of study or selected sections of the area,
b) an increase (or decrease) in the actual emissions from individual vehicles carrying out the same O-D trip in both with and without project cases; or
c) an increase (or decrease) in the concentration of emissions in areas directly adjacent to populated areas or sensitive specific sites.

From the traffic forecasts it is clear that both cases a) and c) are met, i.e., overall traffic volumes in the area will be affected and specific sites will incur different emission concentrations.

Debate over whether the investment required for the new road should be channelled into alternative, less polluting, and or more energy efficient forms of transport, is moot. Similarly, it is considered that the attribution of impacts at the global scale, contribution to the greenhouse effect and climate modification, is unrealistic and that the appropriate disbenefits in this context are highlighted in the defined impact on the national energy budget, Section 8.6.

A two element assessment was carried out:

- Estimation of the overall pollutant load in the study area in with and without project cases.
- Estimation of localised changes in air quality at specific selected sites.

8.5.2 Urban Area Benefits

The ARR is expected to improve transportation efficiency in the urban centre as a result of reduced congestion. It is predicted that as a result of the construction of the ARR overall network speeds will increase as indicated in Table 8.6.

Table 8.6 Modelled Network Speeds[2] (kph)

	Without	With Project Case
2003	41.1	41.4
2008	32.7	33.0
2013	25.3	25.9
2022	18.9	20.0

In theory, as speeds increase emissions will decrease resulting in a net improvement in overall air quality that will in turn translate into improved health and other related benefits.

Inherent in this analysis are two assumptions:

- that defined levels of vehicle emissions can be determined for the present and the future project years.
- that traffic volumes and vehicle mix can be predicted.

[2] With Eastern By Pass Only (not entire Ring Road) for Base Case

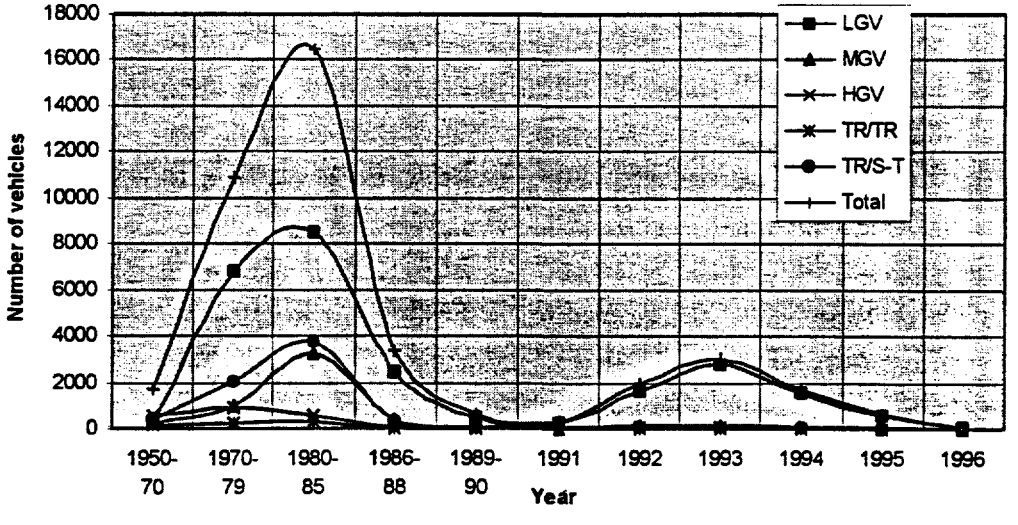
Definition of Vehicle Pollution Emissions

In any calculation of traffic induced pollution definition of the values attributed to individual vehicular emissions in a traffic flow is the most contentious aspect since it must incorporate a wide range of specific values to categorise the vehicle fleet, both at present and in the future, namely.

- classification into vehicle fuel types, petrol, diesel, leaded, unleaded, LNG, etc.
- classification of fleet by vehicle age and the relationship between vehicle age and emission levels.
- classification of the fleet into maintenance categories and the relationship between maintenance and efficiency in combustion and emission load.

The approach utilised in this report is based on the values adopted for trunk roads in the UK using empirical data available from UK studies. This approach permits consistency in the analytical approach for both levels of study. However, the UK data was found to be unsuitable for use for the Amman vehicle fleet, which is considerably older and less clean. This is perhaps best reflected in Figure 8.3 which shows the age of the key Truck sector of the fleet.

Figure 8.3: Age Structure of Licensed Goods Vehicles in Jordan 1950-1996



The passenger car fleet (cars and pickups) is estimated at 10 - 12 years perhaps double that of the UK fleet. Similarly, there are in place no guidelines or target policies for vehicle emissions that may influence the types of vehicle that may be purchased in the future. Accordingly, it is assumed that the 1995 UK fleet can be utilised for the period to 2008.

In preparing a relative comparison between with and without project cases this assumption should not have significant implications. It is however far more significant in assessing the absolute values to be obtained and in assessing potential health implications.

In the former case the assessment is assumed to reflect something of a worst case and is therefore appropriate for assessment against defined guidelines. It is less satisfactory when assessing the potential benefits from reduced health impacts. Accordingly in this specific case, a sensitivity analysis in which the UK fleet adjustment parameters for years beyond 1995 are applied from 2003 implying an eight year lag.

Traffic Volumes and Vehicle Mix and Speed

The basic traffic parameters utilised are those used in the noise modelling exercise and contained in Table 8.1.

Total Emission Estimation

The estimated total emission levels for the with and without project cases are provided in Table 8.7. The detailed calculations and assumptions contained therein are provided in Appendix J to this report.

Table 8.7 Estimated Emission Levels (tons/ year)

	2003			2013		
	CO	NOx	HC	CO	NOx	HC
Without	171.51	70.04	19.69	541.48	156.70	57.59
With	170.11	69.24	19.54	530.72	154.60	56.61
Annual Reduction						
Tons p.a.	1.4	0.80	0.13	10.76	2.10	0.99
As percentage of Without Case	0.82	1.14	0.66	1.99	1.34	1.72

Source: Consultants Estimates

These are clearly abstract numbers and provide only the broadest indication of potential benefits. In particular they are likely to underestimate the true level of emissions. Three factors would support this view:

- The calculations incorporate an assumed substantial improvement in vehicle technology with associated reductions in emission levels that may not be achieved.
- Given the already poor atmospheric quality in the study region any substantial addition to the pollutant load will have greater marginal impact.
- The calculations utilise UK data and will not adequately accommodate the increase in emissions expected during periods when intensive use of air conditioning systems can be expected. International studies suggest that an increase of 15 and 30 % can be expected in CO and NOx emissions respectively under these conditions.

There are no recent estimates of the pollutant load emitted into the Amman - Zarqa airshed from all sources and as such it is not possible to assess the precise significance of reduction in mobile source emissions. Nevertheless, assuming that mobile emissions account for a very substantial proportion of the emissions (Table 8.8) significant benefits may be attributed.

Table 8.8 Mobile Source Contribution to Regional Pollution (%)

	NOx	CO	VOCs	CO_2	SO_2	PM_{10}	BS
Vehicles	52	90	37	19	2	27	42
Other	48	10	63	81	98	63	58
Total	100	100	100	100	100	100	100
Jordan High							
Vehicles	75	90	37	19	2	27	42
Other	25	10	63	81	98	63	58
Total	100	100	100	100	100	100	100
Jordan Low							
Vehicles	50	90	37	19	2	27	42
Other	0	10	63	81	98	63	58
Total	100	100	100	100	100	100	100

8.5.3 Localised Air Quality Assessment

Estimation of the localised impacts of the project requires:

- Definition of receptor sites
- Calculation of the effective traffic flow, where effective traffic flow equates to a nominal figure estimated to reflect 1990 petrol car units in the peak hour.
- Estimation of vehicle speed at the point nearest the receptor
- Estimation of the pollutant load for each of the major pollutants. In this case CO, Hydrocarbons and NOx are estimated. In this regard CO is taken as the primary indicator of modified air quality primarily because it is chemically inert and is produced almost entirely by vehicular traffic.

Definition of receptor sites

Two classes of receptor are defined:

- Sensitive sites (as per the Noise analysis). In this case however the University sites exceeded the maximum 200m distance criteria stipulated for the air quality assessment technique utilised and is therefore excluded from the analysis.

- General locations expected to receive substantial air quality deterioration, two specific site were identified as likely to experience excessive increases emission loads. The values derived for the schools (which are located primarily within the urban areas) can be utilised to provide an overall assessment of the likely impact of the project on air quality in residential areas. The sites defined are located and can be referred to in Figure 8.2.

(i) Sensitive Sites

Effective Traffic Flow

The detailed calculations of effective traffic flows and the overall estimation of pollution loads for each location are contained in Appendix K.

Estimation of Pollutant Loads

The base calculations are estimates for the average peak hour. For comparison to international standards they require adjustment as follows:

- CO: Estimation of the annual maximum 8 hour average concentration
- NOx: Estimate the 98th percentile of 1 Hour NO2

Conversion for hydrocarbons is not undertaken as, in general terms forecast hydrocarbon concentrations cannot be readily assessed with respect to air quality standards. The converted values for each site are contained in Tables 8.9 and 8.10.

These tables also incorporate a comparison with recommended EEC and Malaysian guidelines.

Table 8.9 Estimates of concentrations as percentages of Air Quality Standards: Sensitive Sites

Carbon Monoxide (ppm)

	2003 Do Nothing		2003 Do Something		2008 Do Nothing		2008 Do Something	
Location	Max. 8 hr	% of Standard	Max. 8 hr	% of Standard	Max. 8 hr	% of Standard	Max. 8 hr	% of Standard
Hotel	1.509	16.763	1.507	16.740	3.189	35.434	2.975	33.052
Cemetery (East)	0.019	0.207	0.200	2.218	0.025	0.273	0.360	4.003
Cemetery (West)	0.000	0.000	0.120	1.330	0.000	0.000	0.243	2.695
Zarqa College	0.000	0.000	1.931	21.454	0.000	0.000	3.044	33.827
Mosque	4.512	50.131	5.418	60.195	5.662	62.913	6.661	74.007
Zarqa School 1	0.244	2.706	0.335	3.726	0.401	4.453	0.474	5.262
Zarqa School 2	0.156	1.729	0.214	2.381	0.256	2.845	0.303	3.362

Oxides of Nitrogen (ppb)

	2003 Do Nothing		2003 Do Something		2008 Do Nothing		2008 Do Something	
Location	98^{th} percentile	% of Standard		% of Standard		% of Standard		% of Standard
Hotel	57.892	55.135	56.753	54.051	63.140	60.133	62.602	59.621
Cemetery (East)	7.898	7.522	38.093	36.279	10.382	9.887	42.884	40.842
Cemetery (West)	0.000	0.000	35.855	34.148	0.000	0.000	40.980	39.029
Zarqa College	0.000	0.000	75.996	72.377	0.000	0.000	88.262	84.059
Mosque	80.226	76.405	100.659	95.865	92.732	88.316	120.368	114.636
Zarqa School 1	33.493	31.898	35.529	33.837	37.716	35.920	39.347	37.474
Zarqa School 2	22.519	21.446	29.266	27.872	33.671	32.068	34.712	33.059

Table 8.10 International Standards

Malaysian Guidelines				
Pollutant	Averaging Time	(ppm)	(ug/m3)	Target Year for Compliance
Carbon Monoxide	1 hour	30	34 mg/m3	1995
	8 hour	9	10 mg / m3	
Nitrogen Dioxide	1 hour	0.17	320	1990
European Community Air Standards				
Pollutant	Regulation	Type	Period	Value
Nitrogen Dioxide	85/203/EEC	Limit Value	98th percentile of yearly mean hourly concentration	200 ug/m3
		Guide Value	ditto	135 ug/m3
		Guide Value	50th percentile of etc.	50 ug/m3
Carbon Monoxide	85/203/EEC	Limit Value	8 hour	9 ppm

Source: DOE and UK Dept of Transport, 1994 Recommended Malaysian Guidelines (JAS 1989)

Impact Assessment

From Tables 8.9 and 8.10 the following conclusions are drawn:

- At the year of opening no site is projected to exceed either standard. The Mosque, on the Old Zarqa Road is by far and away the most problematic site exceeding the NOx standard in 2008.

- There is little significant difference between the with and without project cases, invariably less than a 5 point shift in the percentage of standard achieved.

- CO values in the year 2005 do not increase at any of the problem sites. Increases in traffic volumes are more than compensated for by the assumed improvement in vehicle efficiencies inherent in the calculations. In both the with and without project cases four of the six 1997 sites retain values above the standard.

(ii) Road Sections

A similar approach is taken for typical road sections providing the results outlined in Table 8.11.

Table 8.11 Typical Road Section Air Quality
Carbon Monoxide

	2003 Do Nothing		2003 Do Something		2008 Do Nothing		2008 Do Something	
Location		**% of**		**% of**		**% of**		**% of**
	Max. 8 hr	**Standard**	**Max. 8 hr**	**Standard**	**Max. 8 hr**	**Standard**	**Max. 8 hr**	**Standard**
15 m From Desert Highway	2.286	25.399	2.155	23.940	3.321	36.897	3.345	37.169
15 m From Yadoudah Road	3.811	42.347	3.813	42.363	7.206	80.072	5.900	65.560
15 m From Sahab Road	4.470	49.670	4.176	46.403	6.859	76.212	5.805	64.495
15 m From Hizam Road	1.959	21.762	1.443	16.031	3.769	41.876	2.519	27.988
15 m From Zarqa Highway (West)	3.833	42.587	4.196	46.617	5.229	58.097	5.964	66.266
15 m From Zarqa Highway (East)	3.831	42.570	3.990	44.333	5.227	58.080	4.932	54.805

Oxides of Nitrogen (ppb)

	2003 Do Nothing		2003 Do Something		2008 Do Nothing		2008 Do Something	
Location		**% of**		**% of**		**% of**		**% of**
		Standard		**Standard**		**Standard**		**Standard**
15 m From Desert Highway	58.329	55.551	57.236	54.510	60.012	57.155	60.960	58.057
15 m From Yadoudah Road	69.441	66.134	68.390	65.133	79.860	76.057	75.096	71.520
15 m From Sahab Road	98.403	93.717	93.635	89.176	135.854	129.385	120.333	114.603
15 m From Hizam Road	88.350	84.143	76.913	73.250	121.804	116.004	93.506	89.053
15 m From Zarqa Highway (West)	71.064	67.680	70.248	66.902	78.260	74.533	76.889	73.228
15 m From Zarqa Highway (East)	71.061	67.677	70.173	66.831	78.258	74.531	75.337	71.750

- With the single exception of the Hizam Road site there is virtually no difference between the with and without project cases. Significantly, levels at this site are projected to be above and below the NOx standards in the without and with cases respectively.

8.5.4 Health Benefits

Benefits and in particular monetary benefits to reduced emissions at sites remote from the project corridors could not be attributed in this project case. The traffic model projects only very marginally higher network speeds in the with project case and does not permit the isolation of the impact sensitive Amman or Zarqa central areas.

It is possible that more clear-cut benefits may be attributed at the sub-regional level to locations in the vicinity of the existing ring road sections but in this case it is argued that the data available (on all aspects of the assessment, existing health, dispersion rates, traffic fleet and does response functions) is so weak that any benefits attributed will be no more or less

than valid than a qualitative statement. In this case it is the Consultants view that the Project is largely neutral in its effect.

8.6 ENERGY BUDGET

Similar conditions apply to the definition of the impact of the proposed road on the national energy budget as applied in the case of air pollution, i.e. that in order to have a negative impact the project must:

(i) increase overall fuel consumption in the project area either, through generated traffic or, increased consumption per unit (tonne or passenger km) after diversion from other modes.
(ii) increase the actual consumption of individual vehicles making the same O-D, journey in the with and without project case.
(iii) generate an overall increase in the distance travelled in undertaking the same trip matrix

The latter condition here is taken as a surrogate value for the analysis. An initial review of the traffic forecasts indicates that overall distance travelled by the combined total trip matrix in the study area will increase in the with project case as follows:

2003	- 0.08%
2008	+ 0.06%
2013	+ 0.1%
2022	+ 0.8%

The increase in distance defined above is attributed largely to the perceived effect of congestion; i.e. people will travel further to avoid delays.

8.7 SAFETY

8.7.1 Accidents

The number of road accidents in Jordan continues to increase on a year-by-year basis both in absolute terms and when related to other factors; population, vehicle ownership and vehicle use. The numbers of accidents between 1992 and 1996, detailed in Table 8.12, rose at an alarming rate, 13% growth per annum.

Table 8.12: Number and Type of Accidents (1992-1996)

	1992	1993	1994	1995	1996
Total Number of Accidents	20970	24799	26837	28970	33784
Casualties					
Fatalities	388	440	443	469	552
Injuries	10676	11754	12516	13184	15375
Total	11064	12194	12959	13653	15927

Source: Statistics Year Book - 1996

In 1996 the 33,784 accidents resulted in 552 fatalities and 15,375 injuries of which 16% involved pedestrians. The total cost to society was estimated to be in the region of JD 117 million.

The major causes of road accidents in 1996 were:

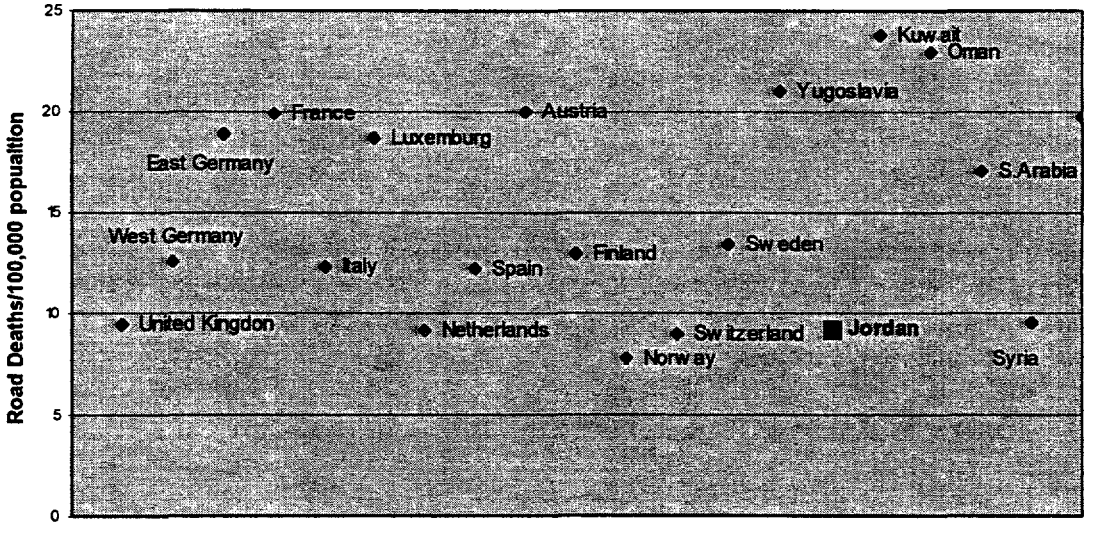
- Driving too close to other vehicles 16%
- Poor lane discipline 14%
- Not giving priority to other vehicles 11%
- Not giving priority to pedestrians 10%
- reverse 6.2%
- Excessive speed 6%
- Not stopping for lights and disobeying signs 4.9%

Road accident levels for 1997 were estimated from 1996 data by applying an average growth factor (1992-1996). These result in a forecast for 1997 of 602 deaths and 16,843 injuries in road accidents.

A comparison of the number of accidents per 100,000 population for 1990 between European and Regional countries is shown in Figure 8.6. In this context, Jordan's record seems relatively good, with just over 9 fatalities / 100,000 population. This rate has, however, gradually increased to 12 fatalities / 100,000 population in 1996, an increase of 5% per annum. Comparing fatality rates per 10,000 vehicles, Jordan's rate of 18.5 is far less satisfactory and around 10 times higher than most developed countries .

The number of accidents by region is shown in Figure 8.4, and it is evident that 70% of national accidents occur within the Amman/Zarqa conurbation, i.e. around 24500, with some 10500 in the rest of the country.

Figure 8.4: International Road Deaths per 100,000 Popualtion - 1990



Applying these values to the number of vehicle kilometres travelled, derived from the model gives accident rates of:

- 10.02 accidents per million veh-km in the urban area
- 4.55 accidents per million vehicle -km in the rest of the country

Based on the traffic model forecast vehicle kilometres, for the with and without Project cases, a reduction in accidents of some 360 is achieved:

Monetary values are applied to these costs in the Economic and Financial analysis (Volume 1) and provide for benefits of some JD 1.2 million at the year of opening as outlined in Table 8.13:

Table 8.13: Weighted Accident Costs in Jordan - 1990

Area	Severity	Indirect Costs Average cost per accident (JD)	Direct Costs Average cost per accident (JD)	Total Costs (JD) Average cost per accident
Urban	Fatal	31,682	3,750	35,432
Urban	Injury	1,432	1,636	3,068
Urban	Property damage only	-	850	850
Rural	Fatal	50,261	6077	56,338
Rural	Injury	1,984	2,041	4,025
Rural	Property damage only	-	1,131	1,131

Source: Consultants estimates derived from the "Study of Road Accident Costs in Jordan Al Omari, 1992.

In addition to this overall perceived benefit there is also some potential for reducing future accident rates at specific locations. In a recent press article (Box 1) the Head of the Traffic Department is quoted as noting

'that the largest group, 90.9 per cent, of the accident victims in 1996 were children aged 15 years and below, followed by youths aged 16 to 20 years. He attributed this to several factors, including the fact that most schools are built on main streets where traffic rules, disregard of motorists for pedestrians at crossings, and the lack of playgrounds and gardens for children to play and spend their free time'

Box 1[3] **ACCIDENTS**

The Traffic Department Tuesday released accident figures for the week of Oct. 18-25, which showed that 674 accidents killed 14 people and injured 30 others. The department said most of the victims were between 21 and 30 years of age. Jordan last year witnessed 33,784 road accidents, which killed 552 people, injured 15,375 others, and caused material losses estimated at JD 100 million, expected to rise to JD250 million by the end of the century, according to the Head of the Traffic Department, Tuesday. In a lecture delivered at the Amman Rotary Club, the Head of the Traffic Department attributed the high number of vehicles on the roads following the 1993 economic boom.

However, the growth in population and the number of vehicles was not coupled with appropriate city planning and the development of the road network, he said.

The Head of the Traffic Department noted that the largest group, 90.9 per cent, of the accident victims in 1996 were children aged 15 years and below, followed by youths aged 16 to 20 years. He attributed this to several factors, including the fact that most schools are built on main streets where traffic rules, disregard of motorists for pedestrians at crossings, and the lack of playgrounds and gardens for children to play and spend their free time.

A Traffic Department survey revealed that 83.2 per cent of road accidents are the fault of the drivers, and most accidents occur because motorists ignore traffic rules, exceed speed limits, drive under the influence of alcohol, and in the case of public vehicle drivers, work long hours, according to the Head of the Traffic Department.

The Head of the Traffic Department proposed that drivers by rehabilitated, road networks be modernised, public awareness campaigns be launched on traffic rules, and stricter control be imposed on the roads.

It is therefore possible for the Project to facilitate future further reductions in accident rate. This may be achieved in two ways:

- by removing high speed through traffic from urban areas / neighbourhoods and thereby facilitating the structuring of local area road infrastructure to limit speeds and protect children.

- by providing for a safe and pleasant recreation area on the Road. To ensure that such provision results in benefits however, it will be necessary to ensure that no other facility associated with the ARR, (including landscaped / grassed verge areas) is utilised for recreation purposes and that the site itself is adequately removed from primary roads.

8.7.2 Hazardous Materials

While the project is considered likely to stimulate economic activity in the Study Area there is no basis for determining that this growth in economic activity will necessarily increase the overall volume of hazardous material transported. Nevertheless, a considerable volume of potentially hazardous material transported in the study corridor, and it is assumed that the majority of this will be transferred from other, urban routes, to the ARR. This will have a number of positive impacts:

[3] Jordan Times – November 1997

(i) It will markedly reduce the potential threat to groundwater resources. Only two sections of the ARR lie over aquifer recharge areas and in both cases the nature of the geology overlying the aquifers inhibits transmission from the surface to the aquifer. Existing highways on the other hand pass over aquifers for their entire length.

(ii) The severity of any accident on the ARR will (with the exception of an accident in Zarqa) be significantly less than a similar accident on alternative routes. Specifically, the relative isolation of the ARR will:

- limit the potential for direct contact with resident populations especially children
- limit effects on transport system and therefore minimise delays costs ands accident potential elsewhere.
- facilitate prompt action by the authorities allowing them to more easily contain and manage the problem

8.8 POLLUTION OF WATER RESOURCES

This section reviews the potential impacts of the Highway on the water resources of the region under three broad headings;

- Pollution of surface water courses by normal highway run off,
- Impacts on impounded waters, and
- Impacts on groundwater resources.

The potential impacts from Highway crossings of drainage channels, and or wadi realignments are not covered. At this stage of project, insufficient data is available on the proposed treatment of each drainage crossing, (bridge, culvert, channelisation, realignment of channel, etc.), location of crossing points, cross sections of wadi channels, surrounding land and, other resource use patterns to permit the detailed evaluation required.

Nevertheless it is important to highlight specific concerns over the section of the road (km 18+250 to km 20+750) in which the main line parallels Wadi Ush.

8.8.1 Pollution of Water Courses by Highway Run Off

All water courses in the region are seasonal at best and carry only spate flows. There is therefore little or no probability of contamination of a water body. This not to say that contaminants are not discharged from the road merely that they are often dispersed or captured between flow events

In addition:

- Traffic loads on the ARR are below the apparent threshold for significant highway pollution to occur.
- Traffic loads in the without project case will be far higher in specific urban areas and thus more of a potential threat.
- the ARR is an exclusively rural road with relatively small AADTs and is therefore unlikely to have the potential to adversely affect water qualities.

The only caveats to these statements would be that:

- Levels of particulate emission are of considerable significance in determining pollutant load. Levels of such emissions are almost certainly far higher in Jordan than in the US. Two factors would contribute to this

  - the percentage of diesel fuelled vehicles in the fleet is probably also higher
  - the vehicle fleet, particularly lorries, is probably older and less well maintained and thus emission levels for each individual vehicle may be higher.

- vegetation, particularly dense ground cover such as grasses, is known to be a major controlling factor in the determination of pollutant loads. The relative vegetation cover at the test sites is unknown but is probably greater than that in the present study area.

8.8.2 Impounded Waters

The proposed road traverses a major catchment that is ultimately impounded at the King Talal dam and the stored water utilised for irrigation purposes. There is no direct discharge from the highway to the reservoir and as such any impacts will be indirect via the Chemical pollution and alteration of sediment load characteristics of the water courses feeding the dam. Given the minimum distance between the Road and the reservoir and the affected lands and the highly periodic nature of flow in the wadis it is extremely unlikely that any pollution from the road will make its

8.8.3 Groundwater Resources

Two sections of road lie over aquifer recharge areas however the aquifers in these areas are relatively deep and are not prone to contamination contaminated normal run off from major highways or chemical spills for that matter. The nature of the geology overlying the aquifers does not promote rapid transmission from the surface to the aquifer through sink holes, fractures and fissures etc

8.9 MAINTENANCE

8.9.1 Landscape Maintenance

The only possible cause for concern in the maintenance of landscaped areas would be the use of chemicals, either fertilisers, or pesticides and herbicides. Three areas of concern may be expressed:

(i) Damage to natural environment or fauna and flora

In this case no potential landscape site is located adjacent to any resource of significant natural value or vulnerability. Accordingly, the threat to natural systems is likely to be minimal, assuming that any chemical use is appropriate and undertaken in a well controlled manner.

(ii) Public health threat from the use of such chemicals in a recreation area.

There is some limited threat from the use of such chemicals in these areas especially if the areas are utilised extensively for food preparation and consumption or are areas to which young children are specifically attracted. used ually limited threat, to the health of users of any landscaped area could also exist.

(iii) Public Health threat to Maintenance operators.

A similar threat is posed to workers that may use the chemicals.

8.9.2 Highway Maintenance

The primary sources of any potentially adverse impact from highway maintenance operations are:

(i) waste material disposal

In this case the main concern will be the solid waste generated from drain clearance operations. This material is likely to be relatively heavily contaminated and should be disposed of in an appropriate fashion.

(ii) accidents

Two types of accidents may occur:

- those involving maintenance staff; and
- those resulting from traffic flow modifications generated by maintenance activities.

The potential significance of these impacts will be a direct function of the quality of the preparatory planning works carried out, the effectiveness of advance warning signs and the quality of the on site supervision.

Though the ARR will pose specific problems to those responsible for maintenance operations these can be easily overcome and there is no reason to believe that the potential risk of an accident should be greater than any other road.

SECTION 9:

INDUCED DEVELOPMENT

SECTION 9: INDUCED DEVELOPMENT

9.1 GENERAL

The ARR use will undoubtedly have a significant impact on the areas through which it traverses. Land patterns are expected to change rapidly as land values increase. This is clearly evident in past periods of speculative activity that have raised land prices and led to extensive parcellation of areas in the vicinity of expected development corridors.

The extent to which the development process has a positive or negative impact will be determined by the quality and extent of the available planning documentation and associated implementation structures.

In a different context, inadequate planning and enforcement will have the dual impact of promoting ad hoc access to the road threatening its operational integrity, and substantially reducing the benefits that may be generated to surrounding populations.

9.2 EXISTING CONCERNS

The review of the planning framework provided earlier in Section 3 indicated that there are some difficulties with the existing planning process. Specifically, there are a number of obvious disparities between the requirements of the current planning legislation on the one hand, and of the practice and administration of development and land use planning and of planning control in the MR on the other.

This is reflected in many ways but most crucially;

- in the absence of approved plans;
- in past relationships between approved plans, subdivision permits, building permits and occupancy permits, and in particular unlicensed development and the post facto licensing of unauthorised development.
- the extent to which the objectives of land use planning are thwarted by the development process and by development as it proceeds.

The issues that arise from this are addressed below under five generic headings.

9.2.1 Lack of Regional Plan

The first area of concern is the lack of an approved plan for the Amman conurbation, the wider Middle Region, and at a local level, within most municipalities.

There are therefore no defined associated regional planning policies that are consistent with national policies and dealing with all aspects of urban and regional land use and development and no master plan or detailed plans for areas within the region that are in compliance with defined regional policies.

Similarly, there is no overall programme for the phasing of development at any level to which the infrastructure agencies can link their sector programmes, nor any framework for the co-ordination of detailed plans for defined districts within the Region.

A Regional Plan has been prepared by the MRP but this has not been the subject of general review and discussion either within government or a wider audience and has not been approved by the MMRAE. Nevertheless, this plan is followed to some degree by the Municipality of Amman and line Ministries in their planning processes.

9.2.2 Profusion of Instruments

The only planning and control instruments in use within the Study Area are extant planning and building regulations and a vast number of detailed land use plan drawings made over the last 30 years; for the most part these have not been brought up to date to reflect current conditions. The drawings, at a wide variety of scales, are based on cadastral maps (and are therefore difficult to relate to actual land use surveys based on topographic maps or air photography). The plans do not deal in any way with the timetabling, programming or phasing of developments.

9.2.3 Overlapping Administrative Domains

Legislation has developed over recent years to deal with specific problems, particularly with regard to the various public utilities, and other services similar to the reorganisation in other countries. However the effect has been to create an overlap of administrative responsibilities which does not pay sufficient regard to the need to the co-ordination of development in urban areas and which does not utilise the resources available in the most effective, efficient and economic manner. Administration and control processes demonstrate an underlying reluctance to define a straightforward structure of responsibilities with clearly defined powers differentiated both vertically (as a hierarchy) and horizontally (spatially and sectorally) within that structure. For example:

a) legislative texts concerning local government determine the organisation, responsibilities, duties and procedures of the various administrative bodies. However, the texts concerning planning specify a quite different hierarchy of legislative administrative roles for the various operations and procedures of plan initiation and implementation;

b) the legislation for a water supply authority gives sole responsibility for the planning and construction of all water and sewerage projects throughout the country to a single agency. This conflicts with the administrative roles allocated in the legislation on local government and on planning and creates major problems for the phasing and control of development;

c) the reservation of land for public uses allowed for in planning legislation is conditioned by the expropriation legislation which limits the reservation period for land not actually used for the intended purpose to 7 years. At the end of this period, the reservation is cancelled and the sites designated land use changes to a non-public land use;

d) Conflicts between the planning and building legislation and regulations; expropriation legislation, and land and survey regulations concerning land registrations subdivision and unification. In urban areas these result in the definition of irregularly shaped parcels, and in buildings with a variety of path and road accesses.

9.2.4 Spatial Overlaps

Similar overlap and contradiction occurs in the spatial delineation of authority. Several different agencies operate in the same geographic area at the same time; with similar function.

For example with regard to the ARR;

(a) the Minister of Municipalities and Rural Affairs and the Environmental Affairs (MMREA), his Department of Regional Planning, the Ministry of Planning, and Supreme Planning Council (SPC) are all responsible for establishing planning policies at national and regional levels. Their duties and responsibilities include the supervision and control of implementation policy, establishing planning standards, preparation and supervision of specific plans. In addition, the MRP is responsible for the preparation of a Regional Plan for the entire area of study.

(b) the planning and provision of public utilities is the responsibility of specialised public agencies and corporations, and of local authorities within their areas;

(c) control and supervision of the implementation of regulations standards and special conditions of planning and building are shared by local councils and District Administrators.

In addition the introduction of new legislation, the effect of which is to amend in part only existing legislation without specifying precisely the sections which are amended or deleted creates difficulties of interpretation and justifies the need to review current law and bring it up to date.

9.2.5 Gaps and Omissions in the Planning Legislation

In addition to problems of overlapping and unclear definition, the existing planning system is also characterised by gaps and omissions. Examples of these shortcomings are:

a) the legislation states that programming and implementation phasing should be built into land use plans but no attempts have been made to do this in past and existing approved plans;

b) the legislative texts do not establish methods of controlling the implementation of phasing proposals.

c) once a land use plan establishes a land use for a particular plot, the owner may develop it whenever he wishes. This makes it difficult to delay development in areas where the timetable for infrastructure provision does not provide for facilities in the short term.

d) the limitation of reservation of land for public purposes to a period not exceeding 7 years makes the reservation of specific sites in areas where development is only time-tabled in the longer term nearly impossible;

e) lack of enforcement capabilities amongst local planning authorities has led to innumerable instances of illegal construction or change of use which seriously undermines the objective of land use planning;

f) established procedures of plan initiation, preparation and approval are characterised by slow routines with only limited opportunity for public participation in setting standards and contributing to the planning of the local environment. Participation is limited to the submission of objections to aspects of a plan which would result in damage to the individual's personal property or in his reduced income or capital. There is little opportunity to question the authorities' planning concepts.

9.3 PROJECT IMPACTS

Given the above project impacts are assessed to be largely negative. In the absence of an effective land use management framework a number of significant adverse effects are expected.

9.3.1 Urban Sprawl and Unplanned Development

The peri urban context of the Project implies that it will almost certainly give rise to an urban sprawl problem. Three forms of development, that may occur by stage, or concurrently, can be expected.

- Roadside commercial development will take place in response to the speculation that improved access and higher visibility will bring customers irrespective of the declared intention that the road be a fully controlled limited access highway.

- Corridor development of industrial and other users will accelerate along primary road corridors provided access to infrastructure networks can be maintained.

- Urban Residential Development. Relative to most other development areas in Amman, that in proximity to Section 1(in particular) is attractive for development. The land is flat, easily developed and will be located between two primary transport corridors, the Desert Highway and the new Ring Road.

As a result of these processes it is probable that development will outstrip infrastructure service capacity and that this in turn will:

- overburden available physical and equally importantly social infrastructure,
- increase the costs of future rates of service provision
- potentially limit the capacity to provide adequate constraining further development options.

In a different, but related context, it is inefficient to plan for amelioration of adverse Project impacts such as severance, local access outside of a planned framework. They are typically prone to interference by landowners who claim exclusive rights to facilities or limit access to them.

9.3.2 Land Use Change

The ARR will undoubtedly lead to further take of agricultural land for urban development. While this is not necessarily a major issue of concern for the lands to the east of the Desert Highway there will also be some additional stimulus for development of the Class I land agricultural lands to the west. This would be in clear contravention of Government Policies on the other side of the Ring Road the recommended actions of the NES.

Such practices are not new. The 1986 Comprehensive Development Plan for Amman noted that:

'the high concentration of population in urban areas, especially in Amman, Zarqa and Irbid, resulted from the availability of services and job opportunities there. This has increased pressure on residential and agricultural lands in these cities; the number of houses which violate zoning plans at the expense of agricultural lands and which lack the minimum services has increased.'

Less significant but still noteworthy is the risk that the area will develop in an environmentally unsound manner. The soils of the area are extremely vulnerable to pulverisation and erosion once the vegetation cover is lost. The absence of development guidelines and an urban planning framework will promote, inappropriate ad hoc development that will not function effectively in the relatively harsh, dusty and hot environment.

9.3.3 Threat to Cultural Resources

The Project CRIS identifies a number of sites that may be adversely affected by the indirect effects of the Project and induced development.

The CRIS provides for some limited protection for these areas with a programme of exploratory surveys however these will need to be supported in the long term by appropriate land use controls if full protection is to be achieved.

9.3.4 Social Concerns

There are three areas of social concern. Firstly that existing tenure systems especially those of the Bedou will be overwhelmed by Project induced development pressures. While a planning document is unlikely to provide full protection for such groups against the aspirations of land owners to maximise their asset value, it is probable that any transition process could be more smoothly accomplished and with less social harm to Customary Rights Users.

This is an issue dealt with more extensively in the Project RAP (Volume 3 of this Report)

Secondly, without the protection of a planning document the entire area will be vulnerable to ad hoc, convenience developments that are incompatible with surrounding uses. This is often a particular problem in areas where small, individual landowners are pitted against a major institution, commercial entity or other interests against whom it is extremely vulnerable, unless protected by the powers contained in planning documents.

Finally, without a planning document that has been the subject of the full process, including Consultation, the development that results is unlikely to reflect the needs wishes and desires of the affected communities.

9.3.5 Road User Preferences

It is a fundamental premise of the project evaluation process that road users make their choices on the basis of a choice set that is restricted to VOCs and time costs. While this is an accepted norm for project feasibility assessments it is possibly too narrow a choice for this project where the characteristics of the majority of the traffic that generate project benefits (long haul traffic to and from Aqaba) are not usual.

Depending on the particular journey to be undertaken it may be that a wider range of factors influence the choice of route. For example.

- Service industries including restaurants, hotels and truck maintenance facilities have developed along primary truck routes in Amman to service the needs of the industry. If such facilities are not available on the ARR will truck drivers still opt to use it.

- Amman may also be home to many very long haul drivers who time and undertake their journeys to allow them an overnight stay with their families. Alternatively they may simply wish to spend a night in Amman.

Are such concerns valid and if so how can they be accommodated in project design and development.

9.3.6 Project Specific Local Area Planning Issues

The ARR will undoubtedly act as a spur to a number of other localised impacts.

The ZTR will have a significant impact on local traffic on each of the three main roads; Zarqa Highway, Old Zarqa Road and Yajouz Road and equally importantly on the movement and linkages between them. The functioning of this local network will therefore have a significant bearing on the functioning of the ARR.

Similarly, there is an increasing trend in Jordan for major road intersections to act as public transport pick and set down points. This reduces the efficiency of the network and increases the risk of accidents. It must be assumed therefore that the ARR interchanges with other major routes will become public transport facilities unless counter measures are taken.

SECTION 10:

PROJECT ALTERNATIVES

SECTION 10: PROJECT ALTERNATIVES

10.1 INTRODUCTION

The Sections of the ARR to be constructed in the works under Appraisal will be assessed as a self standing Eastern By Pass. For this Report, the risk that the additional and remaining sections will not be constructed within a reasonable[1] time frame is considered sufficient to make assessment within the full ring context inappropriate.

The economic feasibility of the project is assessed in Volume 1. The Project objectives that may attributed to an Eastern By Pass are outlined in Section 10.2

The Project Need is assessed in Section 10.3 in the context of a do nothing case derived from the traffic assignment model developed for the Project economic analysis and described in **Section 6 of Volume 1.**

This is followed by a brief review of three alternative do something development options.

- Do Minimum Option
- Policy Option
- By Pass (Ring Road) Option

However, it must be noted that these options are reviewed only to provide a context and rationale for the project. No attempt is made at this time to develop and analyse these options as specific alternative project options or as elements in a composite policy and multi modal development programme. Such options are assumed to have been eliminated from consideration at this time.

Variations to the preferred project alternative are assessed in Section 10.5

10.2 PROJECT OBJECTIVES

The project is conceived as fulfilling a dual Strategic/National and sub regional /local function. At the strategic level it is seen as:

- Facilitating the integration of principal transportation sub-sectors, Air, Sea and Road.
- Promoting growth in the economy and increasing sector development;
- Complementing moves toward greater Regional cooperation and integration in the Transportation Sector.

In the local context the ARR will function as:

- a sub regional By Pass and distributor for peripheral and through traffic, thereby diverting traffic away from the central areas of Amman

[1] Reasonable in this context being reflected in widespread and common recognition that further ARR works are part of the existing Project.

- a local by pass taking through traffic away from and other urban centers such as Sahab, and Zarqa, thereby reducing traffic congestion and pollution along principal urban road corridors
- a heavy truck route (possibly with legislative support) that 'by passes' all urban areas.
- a key economic link reducing the costs of access to, and the integration of a number of major economic centres; Sahab, Hashimiya, Marka, Zarqa and the Zarqa Free Zone.

In a wider context it is also anticipated that the project will serve as a principal framing/structuring element for mid and long term urban planning strategies.

10.3 PROJECT NEED

The need for the project has been assessed in the context of a defined Do Nothing Case. The broad assumptions made for principal forecasting parameters[2] for the Do Nothing Option (DNO) are as follows:

- No physical development of the existing transportation network beyond those projects already under construction or committed, i.e.: Yajouz Road, Madaba Road upgrading and the upgrading of the Inner Ring Road.
- Growth rates in population for the Study Area are in the range 3.5 to 3.0% to 2005 declining to between 2.75 and 2.25% by 2020.
- Traffic growth rates are set at between 5 and 6% per annum.

For evaluation purposes five primary road sections are defined as indicator links of the need for additional highway capacity within a By Pass concept (Figure 10.1).

- Madaba/Juwaida Interchange
- Hizam Road
- Zarqa Highway
- Yajouz Road
- Airport Road to Dead sea interchange

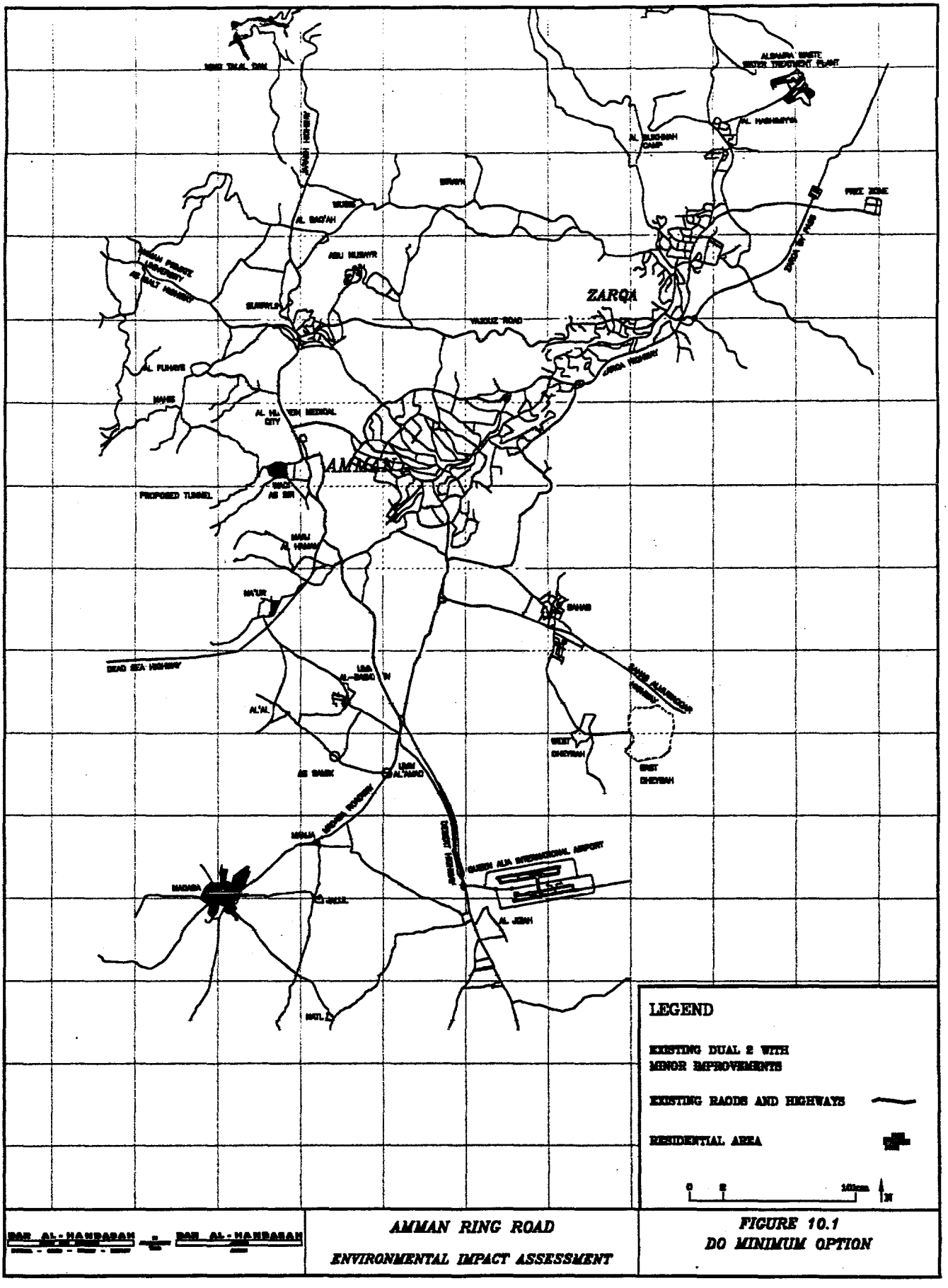
Wider network indicators of time and journey costs in with and without project cases are also utilised.

The results of the model assignment runs together with comments are presented in Table 10.1. These are clear in demonstrating that, with the exception of the Yajouz Road, each indicator section will be approaching or past capacity by the year 2006. These results are derived from trip matrices developed on the basis of very conservative assumptions. Specifically:

- relatively low growth in individual trip making propensity reflecting restricted growth in per capita income and vehicle ownership.

- neutral Regional political environment in which there are no significant changes to the present political situation.

[2] Refer to Section 6 of Volume 1 for a more detailed review of these values



AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 10.1
DO MINIMUM OPTION

Table 10.1 Do - Nothing Capacity Analysis

Link	Traffic Volume 2008	Level of Service 2008	Traffic Volume 2013	Level of Service 2013	Comments
Yadoudeh Road	41,300	D	52,900	E	Capacity reached by 2006
Hizam Road	36,800	D	53,500	F	Capacity reached by 2013
Zarqa Highway	44,000	C	58,000	D-E	Approaching capacity soon after 2013
Yajouz Road	13,300	B	18,800	C-D	Adequate capacity to 2013
Desert Highway to Dead Sea Highway Interchange	13,200	A	21,300	C	Adequate capacity to 2013
Dead Sea interchange to Wadi Eseer (7th circle)	74,500	F	98,200	F	Capacity reached by 2008
Wadi Seer to Jarash Highway	57,300	F	76,200	F	Capacity reached by 2008

Where levels of service for multilane highways are defined as:

LoS A	Free flow conditions with operating vehicles unaffected by the presence of other vehicles.
LoS B	Also indicates free flow conditions, however presence of vehicles starts to be noticed.
LoS C	Represents a range in which the influence of traffic becomes marked. The ability to maneuver within the traffic stream is clearly affected by the presence of other vehicles.
LoS D	Represents a range in which ability to maneuver is restricted because of traffic congestion and traffic speeds are reduced significantly by increasing traffic volumes.
LoS E	Represents operations at or near capacity
LoS F	Represents forced or breakdown flow.

Where levels of service criteria for multilane highways are:

	Free Flow Speed = 96 kph			Free Flow Speed = 72 kph		
Level of Service	Average Speed Kph	Max V/C	Max service flow rate (pcphpl)	Average Speed Kph	Max V/C	Max service flow rate (pcphpl)
A	96	0.33	720	72	0.28	540
B	96	0.55	1,200	72	0.47	900
C	95	0.75	1,650	72	0.66	1,260
D	91	0.89	1,940	70	0.79	1,500
E	88	1.00	2,200	68	1.00	1,900

Note: pcphpl = passenger cars per hour per lane

Source : Highway Capacity Manual, USA 1995

To the extent that is possible the traffic model therefore validates the need for additional capacity in the near future along the major north-south axis to the east of Amman.

If more ambitious forecasts, (High Iraq and West Bank Traffic growth Scenarios) are utilised problems are experienced on the Hizam Road but elsewhere effects are limited.

10.4 ALTERNATIVE DEVELOPMENT OPTIONS

If the validity of the model is accepted, and given that the projections of key parameters in the base case are derived from relatively conservative growth forecasts, this is not unreasonable, it is apparent that the DNO is unsustainable. Accordingly, therefore, alternative Do Something engineering and policy options must be considered. These are outlined briefly below.

10.4.1 Do Minimum Alternative

With total potential overall costs in excess of $US 350 million (for the entire ARR) and a perception that it will run parallel to a number of existing routes that could more easily be upgraded, (especially on the Western Section) there is a case for a Do Minimum Alternative to be assessed.

(i) New Ring Road; Desert Highway - Zarqa - Jerash Road
(ii) Existing Roads from Jerash Highway to Desert Highway, including:

- Jerash Highway - Suweileh, Suweileh Circle
- Suweileh to Deir Ghobar Intersection, 10.5 km 4 lane divided highway.
- Deir Ghobar Intersection to Madaba Interchange, Part of Desert Highway.

The definition of this Option is largely a response to perceived cost and difficulty of construction of the western leg of the ARR and when applied to the Eastern By Pass section only is identical to the Do Nothing Option.

Further upgrading of the existing alternative route, is ruled out by the difficulty in widening the Hizam Road (alternating sections of very difficult terrain and urban development) and the Zarqa Highway.

There are also very strong reservations over the viability of this option under an upgrade scenario. Specifically;

(i) can the investment be safeguarded against continued side friction; and
(ii) can the existing intersections and other link weaknesses be upgraded sufficiently.

In summary the provision of such facilities within an already heavily developed area may be unrealistic at worst and extremely expensive and disruptive, at best.

10.4.2 Policy Options

It is possible to question the need for, and concept of each of the Ring Road and the By-Pass options by arguing that the projected demand need not be met by additional road capacity. That it should either remain unmet, implying a degree of constraint is to be applied to

vehicular movement, or (and) is to be met by alternative development options, i.e. alternative modes.

There are three factors to be considered here.

(i) Modal Substitution

The objectives of the Project outlined in Section 10.2, make it clear that the project is conceived as fulfilling both Strategic, (National and Regional) and local (Amman Region) functions. No single alternative investment is viewed as being able to meet both these objectives.

The primary alternative, heavy rail, will function predominantly along the existing north-south corridor. The existing line is now barely operational and there are no immediate plans for its upgrading and redevelopment. Movements from East to West and from South to East and West are not likely to be available in the immediate or medium short term. Plans have been drawn up for a link from Haifa to Sheikh Hussein Bridge (SHB)and extend it to Amman and beyond but recent studies undertaken for the JRV suggest that only the link between Haifa and SHB is may be viable and even then only by 2020.

Accordingly, present heavy traffic (and normal growth) and any exceptional growth over the medium term from the port of Aqaba will be forced to travel by road.

At the Amman Regional level, the principal concerns are for, local and sub regional, passenger movements. Here lighter, more flexible modes, (LRT etc.) may provide an alternative. Indeed contracts have just been signed for investigation of the options for a Light Rail Project between Zarqa and Amman. This corridor is the most heavily trafficked and provides the best opportunity for LRT development for certainly the next 10-15 years. Connections to other focal points within the urban area may be planned thereafter.

The movements accommodated by this project however are only partly comparable to those projected for the Eastern By Pass where a number of different movements that will reduce congestion in central Amman are facilitated, i.e.

- From west to north east (Dead Sea Highway, Wadi Es Sir),
- Peripheral areas where movements are at present constrained or via the centre (in and out),
- As future development spine will act as the primary distributor as well as interurban highway.

Scheduled bus services have never supplanted Servis taxis as the major public transport mode, though minibuses operating from major intersections (with increasingly detrimental effects) are providing some competition to the Servis. Again therefore, there must be some doubt as to whether an adequate service could be established and maintained outside of the primary corridors.

(ii) Network Efficiency Improvements

With present resource scarcities and with the potential adverse impacts of new Road Projects self evident, it is imperative that options based on maximising the efficiency of use of existing infrastructure are investigated.

With a few notable exceptions (Servis taxi and, increasingly, minibus pick up points at intersections) existing road capacity is generally "well utilised" and driver behaviour though not good, does not strongly impact on road capacity. Instances of excessive side friction and lost capacity from physical damage (potholes etc. stemming from a lack of maintenance) are similarly quite limited.

It is considered very unlikely that the capacity requirements projected as required can be found from the network. Past projects (interchange improvements etc.). Project related proposals to identify and address black spots, and new urban roads being constructed by the Municipality may further relieve some immediate problems but these effects will be localised.

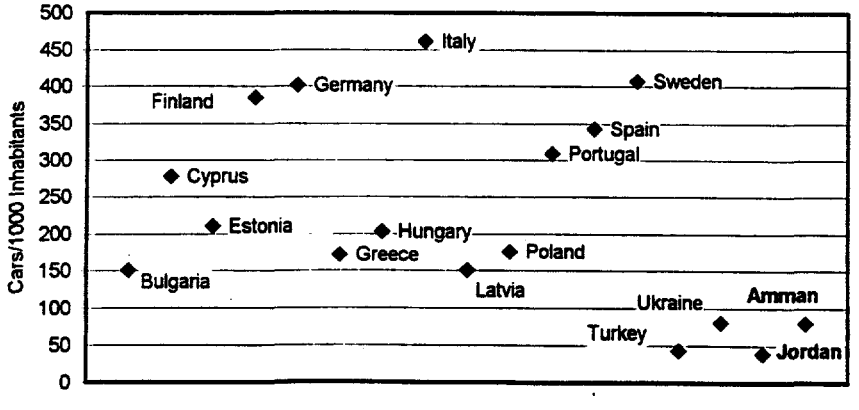
In summary therefore, while some benefits may be gleaned from network efficiency improvements they will not directly substitute for the those attributable to the ARR. These can only be addressed by the existing de facto ring road which, as the analysis of the DNO indicates, will not be able to cope with projected future traffic loads nor can it be upgraded to function as required except at substantially greater cost and risk.

(iii) Demand Management

Demand management is another possible option. However, present levels of vehicle trip making in Amman, estimated at around 0.8 - 1.0 trips per capita per day, are quite low and given the absence of alternative modes would not normally be in the range provoking demand restraint.

In the future, given the pre-existing (and trend) urban structure (low density expansive), relatively low levels of present vehicle ownership (Figure 10.2) and income, it must be expected that as the economy grows, the propensity to make trips will grow at rates greater than unity, irrespective of constraining measures.

Figure 10.2: Car Ownership in Various Countries



(iv) Public Perceptions

As Table 10.2 shows the participants at the Project Scoping Sessions were quite clear in recognising the positive aspects of the proposed Project. In the summary of the most significant impacts (as defined by their ranking as of the highest significance at least two sessions), listed, 6 of the 13 are positive.

In summary, therefore, the following may be concluded;

- There is no single alternative that will meet all the objectives set for the Project. Ultimately, however, it is possible that a composite sector investment package that includes elements of the ring road and alternative modal investments will be implemented over the next twenty years.

Table 10.2 Issues Classed as of the Highest Significance in at Least Two Sessions

	Significance					
Impact	**5**	**4**	**3**	**2**	**1**	**Remarks**
Reduce traffic jams	ZAF					
Inadequate land compensation	ZFA				Z*	*Tribal lands
Loss of forest	A(w) ZF		A(e)			
Impact on natural ground cover	FZ*	Z	A			*Beirain, Shafanbadra areas specified
Air +	ZF	A				May reduce city pollution
Improve Regional / local Transport	FZ	A				
Loss of agricultural land	ZF		A			Western part
Change in land use	AF		Z			
Damage / destruction / displacement of archaeological sites	AF			Z		Conduct survey
Stimulate econ gwth esp. in Tourism	FZ					
Improve National Transport	ZF					
Serve existing economic sectors	FA*	A				*Sector specific
Increase land value	AZ					

Positive Impact

- Levels of trip making at present are low. Moreover, forecast numbers of trips (as utilised in the assignment model) include only normal growth and exclude generated trips. It would therefore seem inappropriate for trip making to be constrained as a matter of policy in the near future.

- There is a strong recognition in the community of the potential need for and benefits from the Project.

Serious doubts must therefore be expressed over the credibility of policy based options and options based on the development of existing links. Nevertheless, it should be noted that strong concerns over the Project and the project concept have been raised in Consultations undertaken for this Phase of the Project and, in particular, over the alignment of the Western Section, at the Fuhais Scoping Session.

10.5 ALTERNATIVE BY PASS OPTIONS

10.5.1 Alignment Options

Three alternative By Pass alignments were originally considered for the Prefeasibility study, A, B and C, with additional Options (in Section 1) subsequently reviewed in Addenda. The basic alignments are shown in Figure 10.3.

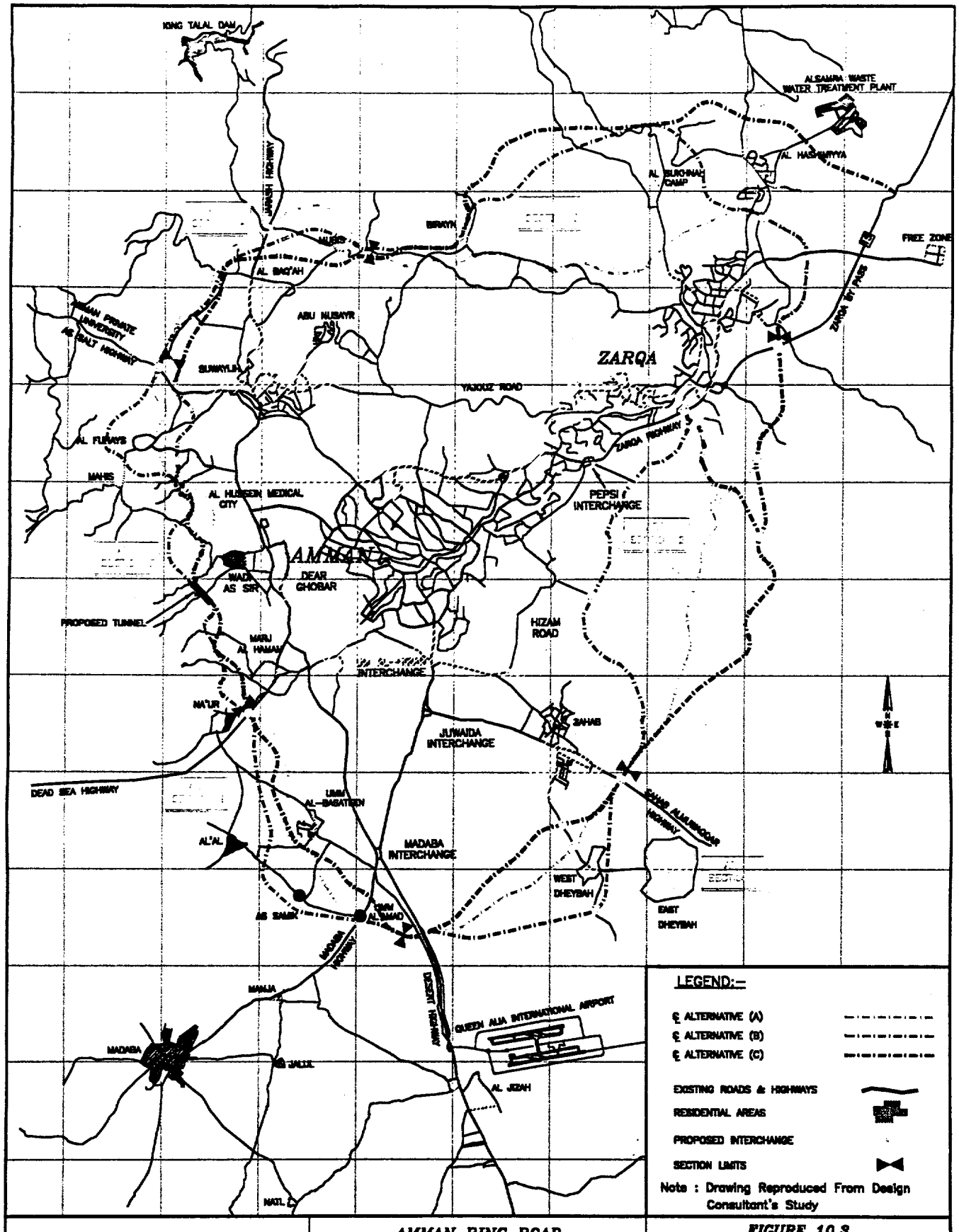
The acquisition requirements of each of these Options are summarised in Table 10.3.

The economic analysis carried out during the Prefeasibility stage, (Volume 1) was clear in confirming that each alternative alignment provides a reasonable return on investment when assessed as built and operational in 2003, providing IRRs of 21.7% (Alternative A) and 22,8% (Alternative B) using a discount rate of 10%, Table 10.5

Table 10.3 Acquisition Requirements:

	Alignment Option			
Section 1	**MR**	**A**	**B**	**C**
Structures				
Buildings		5	12	7
Farm Structures		-	-	-
Army Camps		-	-	-
Greenhouse		15	15	15
Screens, Walls, Fences (m)		300	400	300
Length of Route (kms)				
Parcelled Plots		2.5	3.6	4.0
Forested Lands		-	-	-
Semi Residential Areas / farms		0.5	2.0	1.5
Agricultural Land		10	11	9
Residential		2.2	1.2	0.6
Industrial and Commercial		-	-	-
Army		-	-	-
Other		-	-	-
Section 2				
Structures				
Buildings		7	80	12
Farm Structures		8	-	3
Army Camps		4	15	4
Greenhouse		-	-	-
Screens, Walls, Fences (m)		300	2000	300
Length of Route (kms)				
Parcelled Plots				
Forested Lands				
Semi Residential Areas / farms		2.5	8.5	3.5
Agricultural Land		6.1	2	6.5
Residential				
Industrial and Commercial		1.0	4.4	1.0
Army		6	-	6
Other		15.1	8	17.95

Source: Consolidated Consultants



AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 10.3
ALTERNATIVE ALIGNMENTS

In effect therefore there is a clear economic case to support the Project irrespective of alignment suggesting a strong need for a by pass. The full range of Options considered for the Feasibility Study is shown in Figure 10.4. The principles behind the definition of these various alignments is outlined briefly below by road Section.

Desert Highway - Muwaqqar Highway (Section 1 + Mid Route or Red Route)

Within the Ring Road and By Pass function there is a requirement to link between the Desert Highway and the Muwaqqar Highway (MH), (A and B on Figure 10.5.)

The interchange on the MH must be located either north or south of Sahab. Location to the north would considerably shorten the ARR but would have a number of adverse consequences:

(i) It would not provide significant relief to the urban area. This alignment will pull traffic further into the urban areas rather than out.
(ii) It would not shorten the journey of the potentially very large transit truck movement from Aqaba to Iraq
(iii) It would be substantially more expensive requiring greater property compensation and the acquisition of relatively expensive lands
(iv) It would increase the negative effects of the road in relation to urban areas; severance, noise and air pollution.
(v) It further exacerbates (iii) and (iv) by limiting the options for Western sections of ARR to semi urban areas

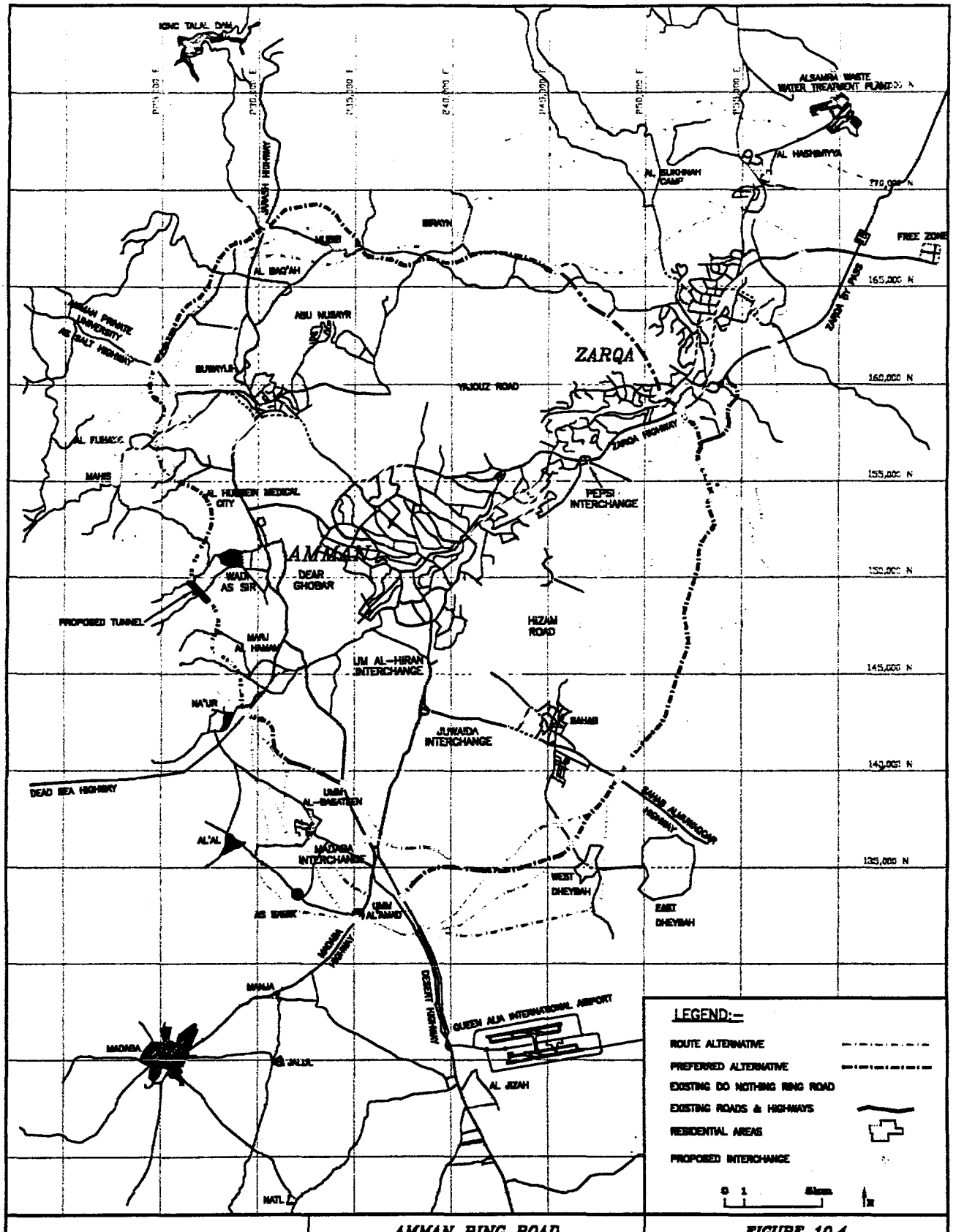
To the east of Sahab only two interchange locations are obvious; between the Cemeteries and east of the Christian Cemetery. Going east of the Cemeteries would involve skirting the settlement of Faisaliyah with consequent lengthening of the line and strong influence on the alignment options to the north.

So restrictive are these constraints imposed elsewhere that the alignment between the two cemeteries was fixed for all options.

South from MH, over 10 alignment options have been considered terminating at one of three intersection points.

- B1: The routes to the north of the Madaba interchange favour east west traffic and function strongly within the Ring Road concept. Benefits to the southern traffic are reduced but even so, the through and transit traffic utilises the By Pass on an almost exclusive basis. Concerns have been expressed that the complex pattern of interchanges in the area, the relatively short distance between them and the combination of movements forced on heavy traffic are far from optimal, and that the option would be expensive to construct.

  Land use patterns are typically peri urban and are more complex than those further from the urban area, to the south. They will thus involve relatively high acquisition and compensation costs and may also incur substantial but as yet undefined other external costs that will need to be internalised to the Project.


KING TALAL DAM
ALSAMRA WASTE WATER TREATMENT PLANT
AL HASHIMIYYA
AL BURGHAH CAMP
FREE ZONE
ZARQA
AMMAN
AL HUSSEIN MEDICAL CITY
PEPSI INTERCHANGE
WADI AS SIR
DEIR GHOBAR
PROPOSED TUNNEL
MARJ AL HAMAM
UM AL-HIRAN INTERCHANGE
HIZAM ROAD
NA'UR
JUWAIDA INTERCHANGE
DEAD SEA HIGHWAY
UMM AL-BASATEEN
AL'AL
MADABA INTERCHANGE
WEST DHEYBAH
EAST DHEYBAH
AS SAMIK
UMM AL'AMAD
AMMAN DESERT HIGHWAY
MAHIS
QUEEN ALIA INTERNATIONAL AIRPORT
AL JIZAH
MADABA
JALUL
NATL
ZARQA BY PASS
YAJOUZ ROAD
AMMAN PRIVATE UNIVERSITY
AIR PORT HIGHWAY
SUWAYLIH
ABU NUSAYR
AL BAQ'AH
IRBAYN
MUSHI
DESERT HIGHWAY
AL FUHAIS
TUNDA HIGHWAY
BAHAB
165,000 N
160,000 N
155,000 N
150,000 N
145,000 N
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135,000 N
LEGEND:-
ROUTE ALTERNATIVE
PREFERRED ALTERNATIVE
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EXISTING ROADS & HIGHWAYS
RESIDENTIAL AREAS
PROPOSED INTERCHANGE
0 1 2km
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DAIR AL-HANBAGAH
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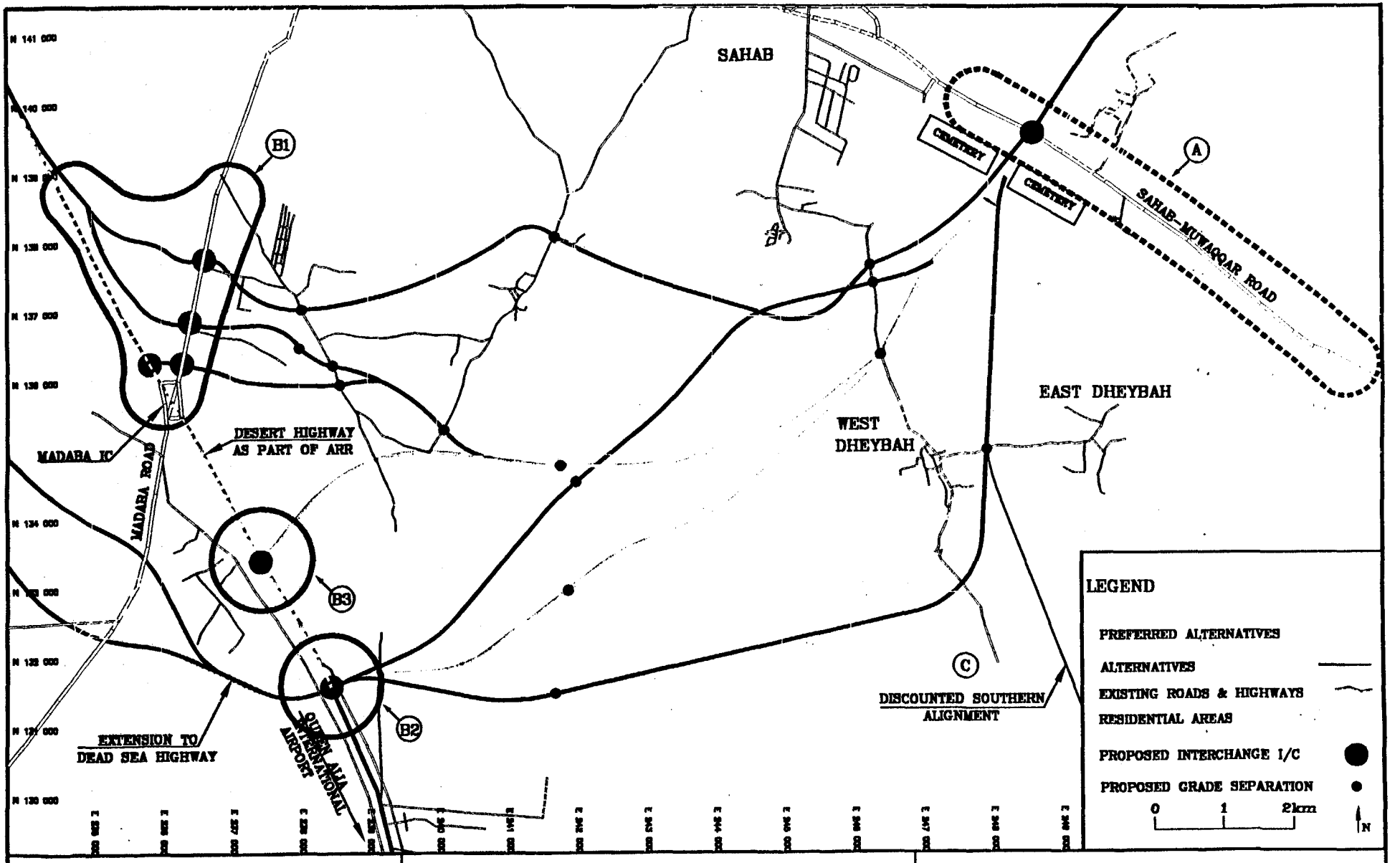
AMMAN RING ROAD
ENVIRONMENTAL IMPACT ASSESSMENT
FIGURE 10.4
ROUTE ALTERNATIVES



DAR AL-HANDASAH = DAR AL-HANDASAH

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FIGURE 10.5
ROUTE ALTERNATIVES OPTIONS
SECTION (1)

North of B1, on the Yadoudah Road, land use intensifies and land values increase to the extent that they make alignment definition sufficiently problematic and costly to warrant little further attention.

- B2: This most southerly option provides for the easiest access and least costly alignment from Sahab. It is also the alignment that most favours the By Pass function for heavy vehicles by shortening journey distances from the south. While some Ring Road function is retained and traffic from Madaba, the Dead Sea Highway and Western Areas of Amman is attracted this preference is considerably reduced when only the Eastern Section is built.

  In a Ring Road context the southern option was originally intended to utilise the existing bridge at the Desert Highway (Al Qastal) to continue on to a south western leg from the Desert Highway to the Dead Sea Highway.

  This option has now been shelved and the future Ring Road using B3 will utilise Sections of the Desert Highway to B4.

- B3: This represents a compromise central solution south of the Madaba interchange. However it achieves little, providing no substantive benefit over either previous case.

Alignments connecting further south than B2 were considered in past studies but were excluded from this Project as being unsustainable within a Ring Road concept, being too long (and thus expensive) and ultimately restricted only to use by traffic from Aqaba. Even local traffic was not expected to utilise the highway.

North of MH

The alignment to the North of the Muwaqqar Highway from the cemetery crossing is defined at a general level by topography. In effect the choice lies between one of three Wadis, D1 to D3 on Figures 10.6 and 10.7.

- D1 Wadi Ush: This Mid route is a strongly by pass oriented option located some 7 kms from the existing Hizam Road and isolated in parts by some difficult terrain. Over the mid to long term this Option will have a significant structural planning function. In the short term it performs well as a By Pass and traverses readily available, low value lands.

- D2 Wadi Daba'a Dehab: This outer route is a residual alternative from earlier studies that proposed a very long by pass distant from the urban area. This will function in a similar way to Wadi Ush and would be in less complex terrain. It is however extremely remote and would have no any planning function.

- D3 Wadi Qattab: This inner route has a strong Ring Road function acting as a regional distributor and drawing traffic from Amman. In the modelling exercise some 20000 additional vehicles per day (additional over the other Options) were projected for this Road. This Option is however relatively expensive, traverses a substantial area of the Russeifa mining concession area and is essentially incompatible with the Draft Development Plans prepared by the Middle Region Planning Office.

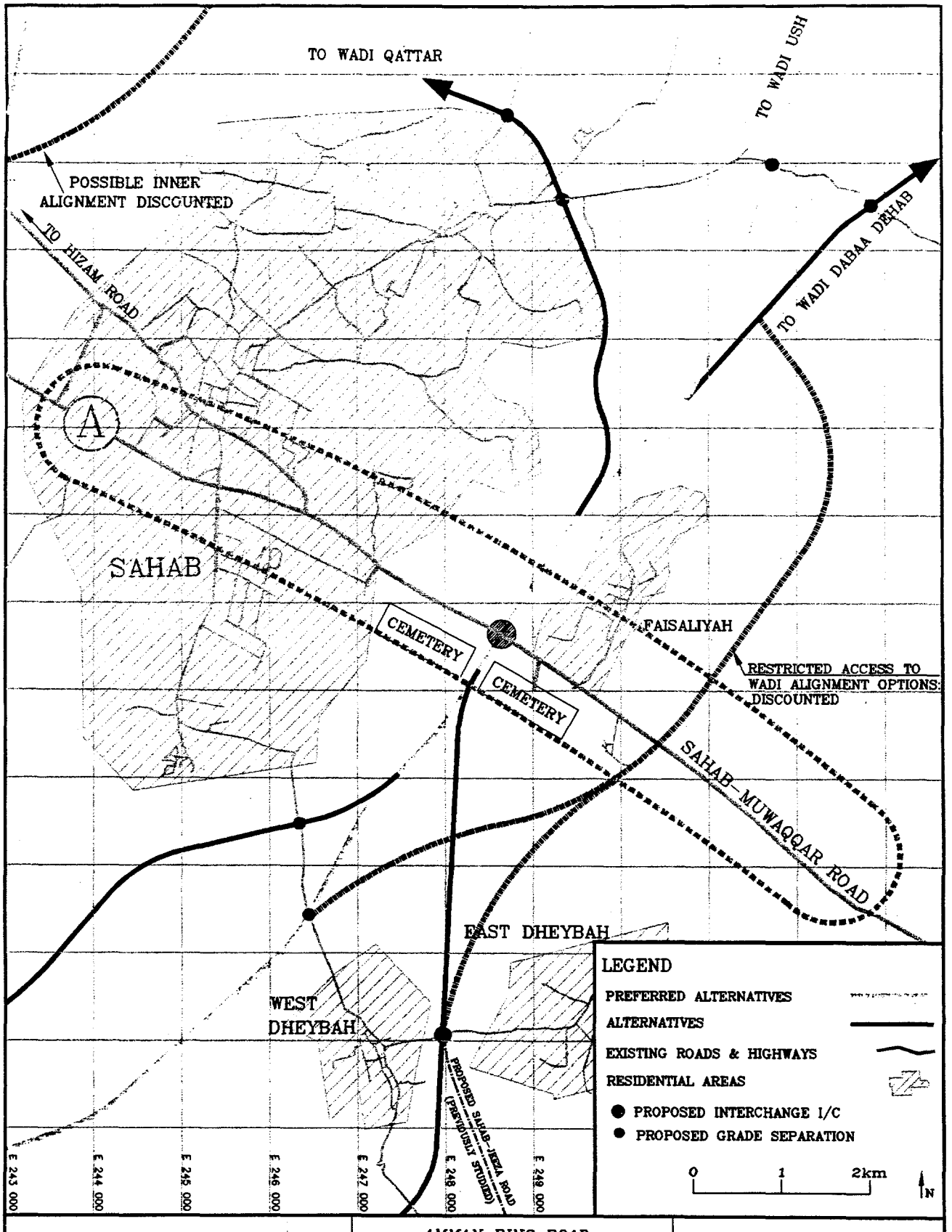

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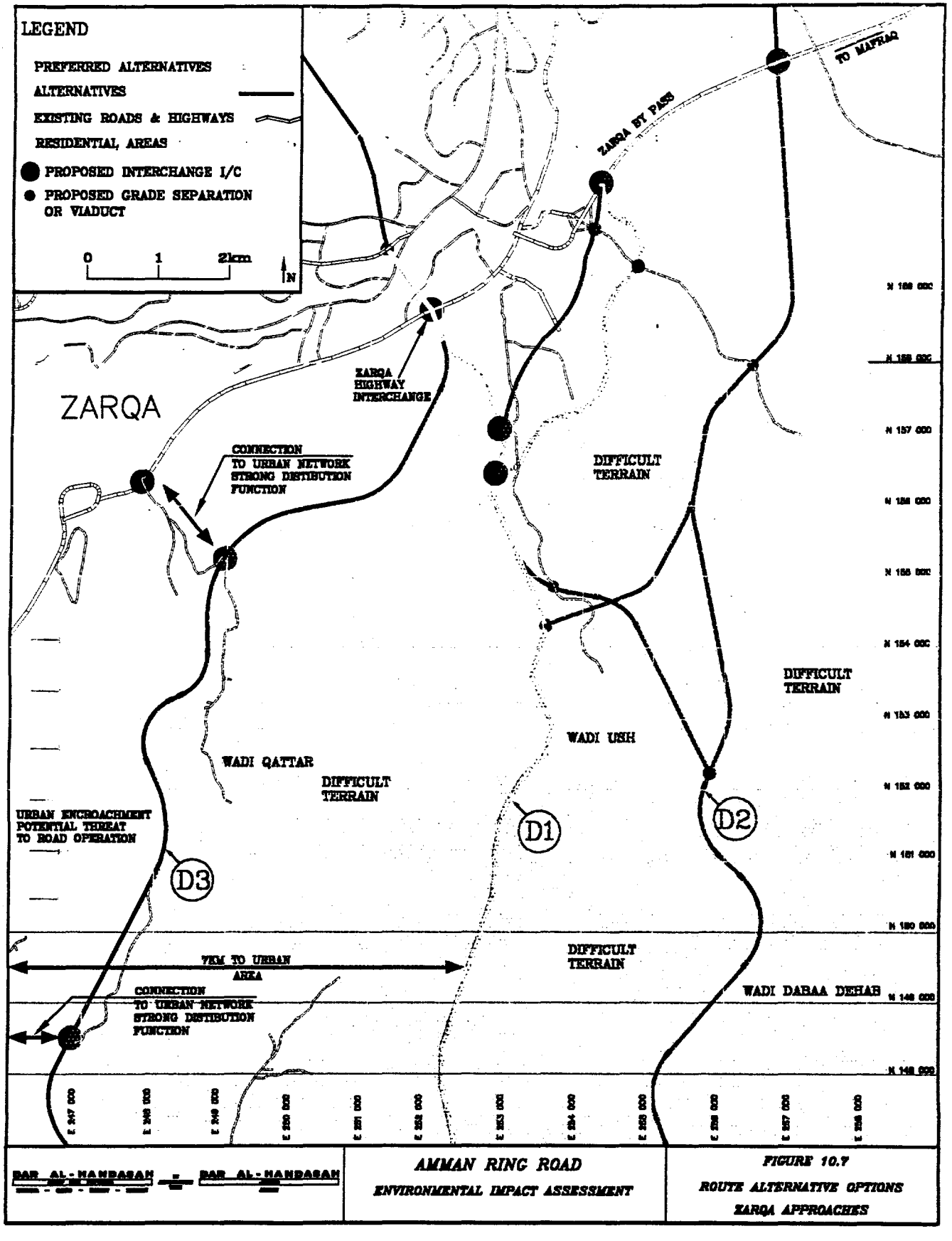
FIGURE 10.6
ROUTE ALTERNATIVE OPTIONS
SAHAB AREA



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AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 10.7

ROUTE ALTERNATIVE OPTIONS

ZARQA APPROACHES

Zarqa Approaches

Options E1 and E2 (on Figures 10.9 and 10.8) are alignments designed to take transit traffic to Zarqa By Pass avoiding the black spot interchange (E4) and use of Zarqa Highway already the busiest road in Kingdom. The two Options are either through or around the industrial area. In simple terms the choice boils down to:

- A short and easy engineering option passing through the industrial area (though not impacting actual production areas), or
- A longer option on more difficult terrain but outside of the Industrial Area.

Option E3 traverses very difficult terrain, is expensive and serves only as a by pass for transit traffic avoiding the Zarqa Highway and the Zarqa By Pass intersection, (E4).

Intersection E5 is either the end point of the eastern Section of the road (with ring road traffic continuing either via E2 or E3) or part of the ZTR (see below). In either case it serves to distribute traffic both within the Zarqa areas and west to Amman and Marka.

Zarqa

At Zarqa there are three basic Options.

- Option F1: Combine the Zarqa By Pass, Mafraq Road (Highway 15) and a new alignment into the ARR. This also acts as an east west northern by pass for Zarqa. However it makes the ARR very long forcing use of northern alignment (F) and it also provides no effective link to Zarqa. This option is very expensive and doesn't work well

- Option F2: is in effect an inner Zarqa ring road. It can utilise the shorter inner alignment and link effectively with all routes in and out of Zarqa and therefore promotes effective distribution. But only for east -west traffic passing to the north of the urban area, one of the smaller strategic movements in the traffic model. This ring may connect to the south at any of E1 to E3. The preferred option is a combination of E1 (Ring Road and Transit Traffic) and E3 (Zarqa and Amman Traffic).

- Option F3 (and D): These are recent proposals intended to shorten this element of the ARR and also permit good distribution of all traffic within Zarqa and to Amman. This Option may utilise either combinations of E1and E2, or E1 and E3. The Zarqa Through Route (ZTR) shortens the Ring Road substantially and satisfies project objectives but at a cost. While the initial Section planned for this Phase will have only limited impacts the later extension north will be more damaging requiring resettlement of some 40 -70 households, (300 -500 people).

  Nevertheless, during a Project scoping session undertaken to specifically review the Options available for Zarqa there was a strong preference expressed for the ZTR but with E3. The selection of E3 reflected concerns that E2 was too close and would be absorbed quickly by urban growth. In a similar context, at the Project Consultation programme, officials and representatives from affected communities in Zarqa and Sahab repeatedly stressed the need for the Project to be associated with or supported by development plans.

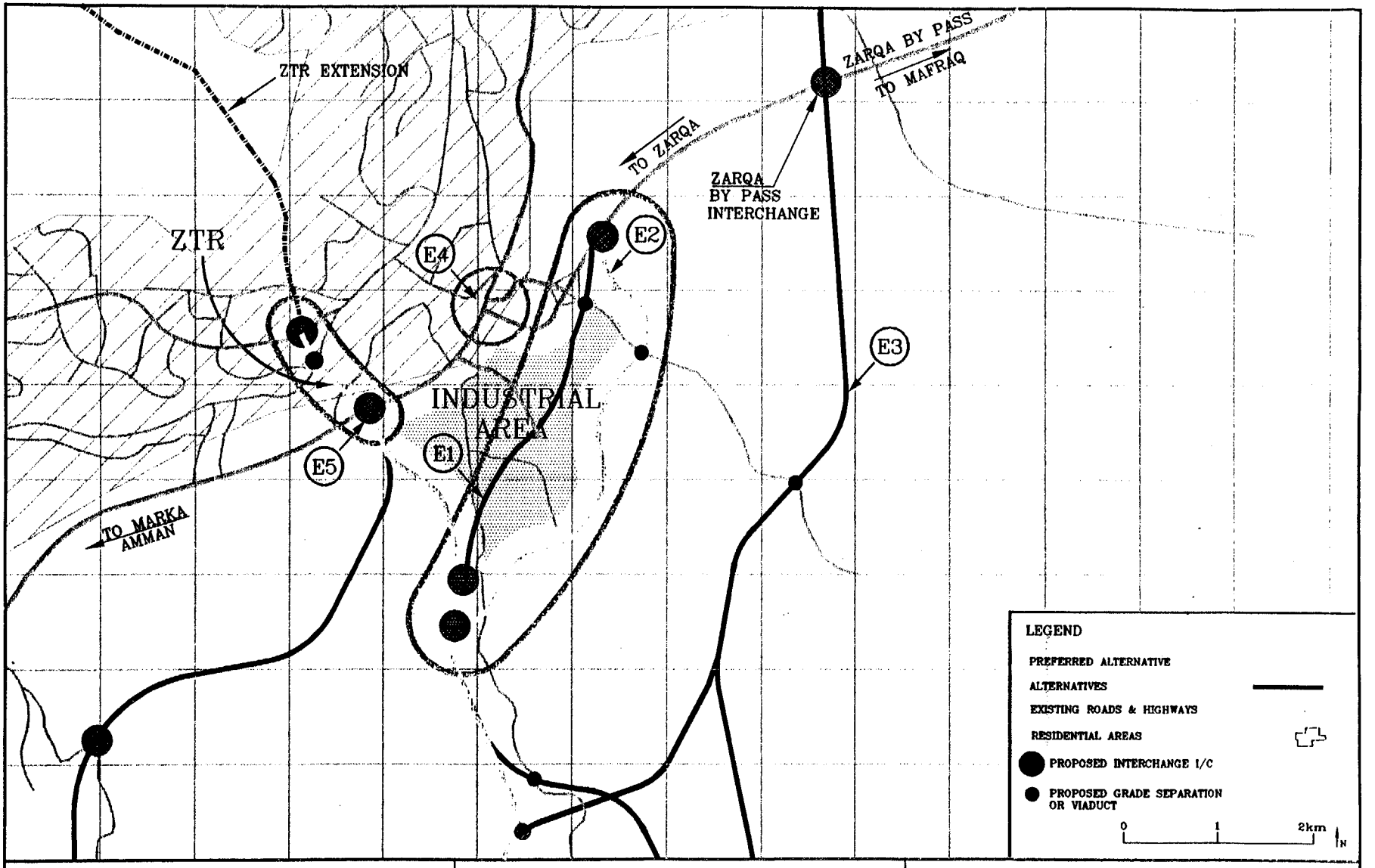

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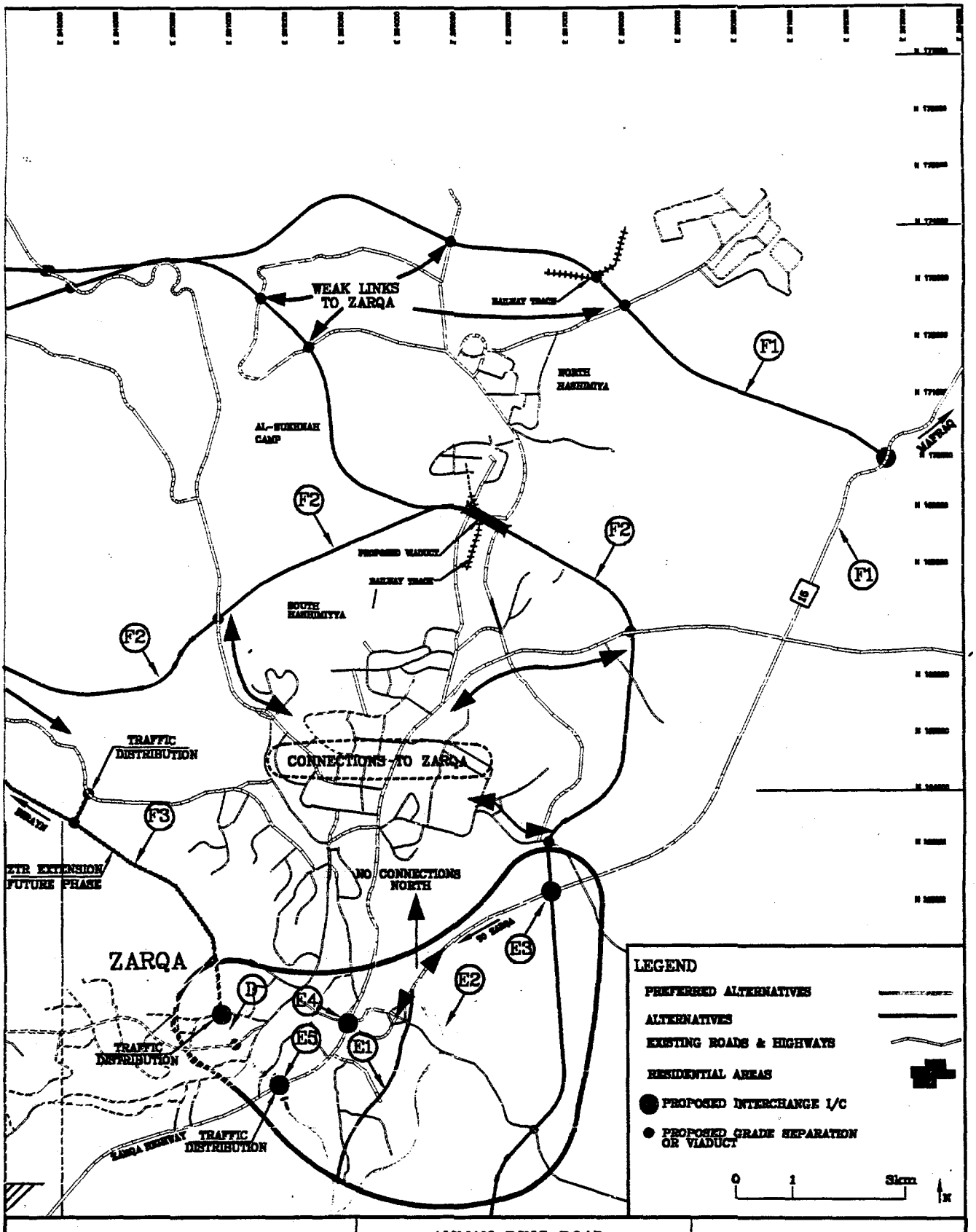
FIGURE 10.8
ROUTE ALTERNATIVES OPTIONS
ZARQA



DAR AL-HANDASAH — DAR AL-HANDASAH

AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 10.9

ROUTE ALTERNATIVES KEY PLAN SECTION (2&3)

10.5.2 Alternative Options

The project was tested as a single carriageway facility and found to open at level of service C. Upgrades of the facility with all the associated difficulties in construction and traffic delays would need to begin almost immediately. It is therefore discounted as true project option.

There are a number of further refinements to the Project that may serve to limit possible negative impacts. These include:

(i) Adoption of the Policy to limit land take to the minimum ROW necessary to accommodate the proposed road cross section.

(ii) Further design reviews to respond to the findings of CRIS, this EA and the guidelines established in the LARP.

SECTION 11:

MITIGATION PLAN

SECTION 11 MITIGATION PLAN

11.1 PRE-CONSTRUCTION

The project will have a further pre construction, detailed design phase. This phase will represent the best opportunity for minimising negative project impacts through design reviews and further consultations.

There are three specific areas of detailed concern:

- Cultural Resource Impacts:
- Land Acquisition
- Drainage concerns

Of these only the latter is considered here. The former two are addressed in the CRIA and LARP respectively.

The drainage concerns relate to the alignment along Wadi Ush where the road and the wadi occupy much the same land. Suitable flat lands are available immediately to the west of the alignment that would resolve the majority of the concerns. The avoidance of these lands appears to be a function of other non highway design parameters. Specifically the ownership of the lands by the Russeifa Mining Company and the development plans that have been made for these lands.

Extensive consultations are required to relocate this section of the road. From all perspectives except that of the Mining Company the present alignment is less than optimal.

11.2 CONSTRUCTION

All of the Construction related impacts defined can be mitigated with the observation of good construction practice and careful on site monitoring by the MPWH.

The following paragraphs indicate the measures that would be required of the contractor to ensure that the potential impact from construction are minimised. Where possible the text is written in a format that would permit direct use in tender documentation.

Each of the mitigation measures proposed should be included in the tender documents and contractors should be made explicitly aware in the Contract documents of their responsibility to the environment. Moreover the MPWH may wish to stipulate that evidence of a strong environmental awareness in the preparation of the bid documents will be considered positively.

Similarly, contractor performance with regard to socio environmental concerns should be the subject of monthly reports by the supervising agency. If it is considered appropriate, the MPWH may introduce a sliding scale of fines to be applied for continued poor performance by the contractor.

Landscape Damage

The contractor shall exercise care to preserve the natural landscape and shall conduct his construction operations so as to prevent any unnecessary destruction, scarring or defacing of the natural surroundings in the vicinity of the work.

Except where clearing is required for permanent works, for approved construction road access, and for excavation operations, all trees, native shrubbery and vegetation shall be preserved and shall be protected from damage that may be caused by the contractors equipment and operations. No trees shall be cut down outside of the ROW without the specific approval of the MPWH.

Movement of crews and equipment within the ROW and over routes defined for access shall be performed in a manner to prevent damage to property, productive lands and known cultural or archaeological sites.

Where unnecessary destruction, scarring or defacing of landscape, natural vegetation or productive lands has occurred the contractor shall be responsible for repair, replanting or otherwise correction at the his own expense.

On completion of works, and in addition to the requirements contained elsewhere, all work areas shall be smoothed and graded in a manner to conform to the natural appearance of the surrounding landscape.

Archaeological / Heritage Sites

The chance find procedures in operation in Jordan defined in the agreement between MPWH and DAJ; Guidelines For Co-ordination at Regional Level, (paragraphs 'd to g' page 6). These are included as Appendix L to this report.

Dislocation of Local Access

It is recommended that a detailed study of local access and agricultural access requirements is conducted along the alignment in order to determine the significance (including seasonal significance) of the various local access routes to ensure that an appropriate programme of diversions and associated signage can be developed. On the basis of the information contained in this programme, the contractor should prepare a plan of diversions and temporary works for approval by the MPWH. In addition to the details of the proposed works and signage the plan should contain also contain details of the timing of the proposed closure and works, start date of works, closure of route, opening of route, programme of making good.

Utilities Damage

The Contractor shall liaise with the agencies responsible for the maintenance of utilities that may be crossed, temporarily diverted or in any other way affected by construction works as to the timing and nature of the works proposed. Where required by Jordanian law or sensible practise the responsible agency shall be requested to carry out the works necessary, at the time required, by the MPWH and at the MPWH's cost.

Prior to carrying out any works the Contractor will request of the utility agencies confirmation and definition of all utilities sites in and adjacent to (say within 50 m) all construction sites. Damage to any utility at a defined site will be made good to the satisfaction of the utility agency at cost to the contractor.

Damage to utilities not defined prior to construction will not be the responsibility of the contractor. It shall be the responsibility of the MPWH to ensure that the utilities agencies respond, in good time, to the requests of the contractor for information.

The tender documents will contain sufficient information on utilities crossings and responsibility for works to permit the contractor to include any required works in his offer price.

Access Roads

Three measures are proposed.

(i) The routes of temporary access to alignment should be selected carefully, especially where such roads traverse, or originate in, residential areas in order that they should minimise possible nuisance values to residents, protect properties and most importantly to minimise the risk to public safety.

Details of all proposed access roads, their proposed times of operation (both in terms of the overall contract and daily operations), and the size and loadings of vehicles proposed to use them will be submitted to the relevant authorities for approval.

Wherever possible existing access routes should be utilised.

(ii) The access roads will be subject to a programme of road cleaning works submitted to and approved by the relevant authorities prior to construction.

The alignment and profile of construction access roads shall be subject to the approval of the executing authority. In approving the alignment, profile and ultimately the construction of such roads the MPWH shall consider the long term potential use of the road. In cases where no long term life is anticipated the alignment and profile should be considered bearing in mind the ease with which the road can be returned to its previous use or new use.

(iii) When no longer required by the contractor, construction roads shall be either:

- made impassable to vehicular traffic and the surfaces scarified and left in a condition suitable for natural revegetation or for recovery of productive use

or

- brought to a standard as deemed necessary by the MPWH.

Prevention of Soil Pollution

As noted above the threat of soil pollution is considered to be relatively insignificant. However, the contractor shall be required to perform all construction activities by methods that will prevent pollution of the soil by accidental spillage, of solid matter, contaminants, debris, and other objectionable pollutants. If a significant spillage does occur the contractor will remove all contaminated soil to a site specified by the MPWH for disposal and where necessary appropriate replacement material shall be laid. The costs of these actions shall be borne by the contractor.

Prevention of Water Pollution

The contractor shall comply with applicable regulations concerning the control and abatement of water pollution in force in Jordan at the time of signing of the contract documents.

The contractor's construction activities shall be performed by methods that will be prevent entrance or accidental spillage, of solid matter, contaminants, debris, and other objectionable pollutants and wastes in to streams, water courses, lakes and underground water sources. Such pollutants and wastes include, but are not restricted to;

- refuse
- cement
- concrete
- industrial waste
- oil and other petroleum products
- aggregate processing tailings
- mineral salts
- thermal pollution

In the event of a serious spill, and contamination, the contractor shall notify the agents of MPWH immediately. Any remedial works required by the MPWH shall be undertaken by the contractor or any specified body at the contractors expense. Failure to notify the MPWH of such spills will be considered a breach of contract by the contractor.

Prevention of Erosion and Increased Sedimentation

(i) Discharge Points

All temporary discharge points shall be located, designed and constructed in a manner that will minimise the potential threat of erosion in the receiving channels. Measures to be taken may include placement of drains to avoid cascading effects, localised lining of receiving channels and the construction of a sufficient density of drains to ensure that the potential discharge from any single point is readily manageable.

(ii) Dewatering

Dewatering works for foundations and earthwork operations adjacent to, or encroaching upon streams or water courses shall be conducted in a manner that will prevent turbid water

entering the streams or water courses directly, through the construction of intercepting ditches, settling ponds or other appropriate devices.

Where some, short term, construction work in an existing water course is unavoidable turbidity levels may be allowed to increase beyond those normally acceptable to the MPWH on agreement with the MPWH's representatives. In cases where such measures are known to be unavoidable the contractor shall submit a programme of work outlining any mitigation plans proposed, and the time frame of the required work, to the MPWH for approval.

Similarly no water, under force, shall be permitted to be discharged into existing water courses without due care and attention being paid to the potential threat of erosion and scouring of the channel, downstream of the discharge.

(iii) Site Clearance

Site clearance shall be only be undertaken when immediately required to permit adherence to the defined programme of works. The clearance of extensive areas well in advance of construction works, shall be avoided. The maximum permitted elapsed time between site clearance and the initiation of construction works shall be 3 weeks.

It is strongly recommended here that all top soil removed in the clearing process be stored for possible future use.

This recommendation applies particularly to the soils to be removed from the fertile areas of Sections 1 and the MR or RR. Top soils of this quality represent a valuable resource to the country that should not be discarded without full consideration of the options available for reuse. To this end it is proposed that the MOA Forests department are consulted on possible options for reuse at specific geographical locations.

The implications of this recommendation are extensive in that they require the contractor to:

- adopt an approach to clearance which requires separation of top soil clearance from other site clearance practices
- transport and storage of top soil
- possible transport to reuse site, though this should be the responsibility of the using agency.

(iv) Operations in Unstable Areas

When operating in areas of geological instability the contractor shall exercise particular care in carrying out all works to ensure that the risk of landslip and other mass movements of material are minimised. He shall pay particular regard to:

- all cut operations
- the density of required drainage works
- the nature and types discharge points and the potential for downstream undercutting of unstable banks.

(v) Aggregate, Fill and Spoil, Heaps

The contractor shall wherever possible ensure that all such heaps are located at sites that.

- do not permit direct run off into water courses.
- are generally on flat land, slopes of less than 1.5%

On site storage of excessive quantities of such materials should also be avoided.

Similarly all such heaps shall be of a size and stability that will ensure that the risk of mass movement in periods of high intensity rainfall will be minimised.

Disposal of Surplus Materials

The disposal of all surplus construction material and debris will be carried out in accordance with the regulations stipulated by local authorities. The normal manner of disposal will include all necessary precautions in terms of minimisation of water and air pollution, drainage impedance, fire hazards and damage to ecosystems.

Similarly surplus earth materials will be disposed of promptly in order to minimise time of "storage" at the construction site and hence the risk of erosion and sediment discharge. If necessary surplus materials should be disposed of at the one of the many quarry site in the Northern Section of 2 following agreement with NRA and others as necessary. For Section 1 no surplus is expected, except and unless the material is not useable for construction. Such materials should be stored in an appropriate fashion until required.

Typical uses would include:

- General landscaping works requiring some artificial sculpting of land surfaces
- Use at interchanges to raise land levels within the area enclosed by access ramps
- Catchment protection measures

Abatement of Noise and Air Pollution

The noise from construction activities will be derived primarily from the operation of plant and equipment. In this regard noise levels can be mitigated as follows:

(i) the contractor ensuring that the equipment utilised in the construction of the project is fitted with appropriate noise muffling devices that will conform to the sound level emissions stipulated in Table 11.1 or other appropriate standards.

Table 11.1 Suggested Noise Standards for Construction Equipment

Activity	Source	Limitation Day	Night
Earthwork	bulldozer excavator	75	55
Pile	piling machinery	85	none
Structure	concrete mixer / concrete pump	70	55
Surfacing	Roller	70	55

Equipment not covered in these regulations should, where appropriate and reasonable, be fitted with appropriate muffling devices.

Equipment and vehicles that are excessively noisy, (in relation to the values in Table 11.2 below) either according to the statute or otherwise defined, due to poor engine adjustment, damage to noise amelioration equipment or other inefficient operating conditions shall not be operated unless corrective measures are taken.

Table 11.2 Typical Noise Standards: Motor Vehicle Noise

Category of Vehicle	Maximum Sound Level Permitted (dBA)
Used for the carriage of goods. Permitted maximum weight does not exceed 3.5 tons. Engine is less than 200 hp DIN	81
Used for the carriage of goods. Permitted maximum weight exceeds 3.5 tons. Engine is less than 200 hp DIN	86
Used for the carriage of goods. Permitted maximum weight does not exceed 3.5 tons. Engine is 200 hp DIN or more.	88

Source: Malaysian Environmental Quality Act 1974 and Regulations

(ii) the contractor should ensure that where possible plant and equipment should be located away from noise sensitive areas. In this context loading and unloading operations are particularly important. Where smaller, noisy equipment is in operation it may be placed behind screening or within a temporary enclosure. Where larger equipment is involved in proximity (within 50m) of properties the use of proper hoardings of sufficient length and height should be considered. These will provide some noise attenuation and will in addition provide some visual relief to adjacent land users and serve to suppress the movement of settleable materials outside the construction site.

(iii) the contractor ensuring that plant operated intermittently is shut down, or at a minimum throttled down during idle periods.

In addition, general noise abatement measures, such as those below should be utilised.

- restricting noisy operations to between 7 am and 9 p.m.
- informing the public of the expected time and duration of works that may emit significant noise levels.

Piling operations should be restricted to the hours of 0700 - 2000. Advance notice of work starts of at least one month should also be given to residents or users of properties within 50 metres of a piling site. Such notice may take the form of public notices displayed in within affected neighbourhoods and or through the media.

The linear nature of the site militates against the provision of noise protection for all adjacent that would normally be provided by site security measures such as hoardings. However in one cases it is considered that some protection should be provided where property facades are within fifty metres of a pile site. In keeping with standard international regulations the use of diesel driven hammers will not be permitted.

Similar measures should be considered at other off site facilities though the extent of the measures required will depend on the nature of surrounding land uses and their relative proximity.

Permission to extend periods of operation may be provided by the MPWH or the relevant municipality authority but should as a matter of principle only be approved in two cases:

- an emergency
- in cases where it can be argued that a short period of additional working will provide significant long term benefits to communities affected by construction activity.

Extended periods (> 3days) of overtime working shall not be permitted except in exceptional cases.

- ***Air Pollution excluding dust abatement***

In the conduct of general construction activities and the operation of other equipment, the contractor should be required to utilise all practical methods and devices as are reasonably available to control, prevent and otherwise minimise atmospheric emissions or the discharge of air contaminants. This will include:

- the methods of handling cement and pozzoloid shall include means of eliminating atmospheric discharges of dust.

- equipment and vehicles that show excessive emissions of exhaust gases due to poor engine adjustment or other inefficient operating conditions should not be operated unless corrective measures are taken.

- burning of materials resulting from the clearance of trees, bushes and combustible materials should not be permitted, except on the specific approval of relevant government departments.

The contractor shall comply with applicable regulations concerning the prevention of air pollution in force in Jordan.. In the conduct of construction activities and the operation of equipment, the contractor shall utilise all practical methods and devices as are reasonably available to control, prevent and otherwise minimise atmospheric emissions or the discharge of air contaminants.

Equipment and vehicles that show excessive emissions of exhaust gases due to poor engine adjustment or other inefficient operating conditions shall not be operated unless corrective measures are taken.

Every asphaltic concrete plant and bituminous mixing plant shall not emit or discharge dust or solid particles in excess of the following limits:

Source	Standard A gm/Nm3	Standard B gm/Nm3	Standard C gm/Nm3
Stationary Plant	0.5	0.4	0.3
Mobile Plant	0.7	0.7	0.4

where:

- a mobile plant is defined as plant that operates for a period not exceeding 24 months and which has a rated production capacity not exceeding 60 ton per hour.
- standard C is applicable to all new premises or facilities.

Dust Abatement

During the performance of the work required the contractor should be responsible for all the labour, equipment, materials and other means necessary required, and shall carry out proper and efficient measures, wherever and as often as necessary, to prevent dust that has originated from his operations from damaging dwellings, or causing a nuisance or health hazard to persons.

Specific dust suppression measures, may include :

- the provision of water troughs at entry and exit points to prevent the carry over, beyond the construction site, of dust emissions.
- use of appropriate hoardings, see
- establishment of, and strict compliance with, speed restrictions for all vehicles operating within the construction site, or on access roads to the site.
- using coverings for all vehicles transporting materials likely to give off excessive dust emissions.

During the performance of the work required the contractor shall furnish all the labour, equipment, materials and means required, and shall carry out proper and efficient measures, wherever and as often as necessary, to prevent dust that has originated from his operations from damaging crops, orchards, cultivated fields and dwellings, or causing a nuisance to persons.

The contractor will be held liable for any damage resulting from dust originating from his operations.

The cost of sprinkling, or of other methods of dust control, shall be included in the bid pricing. Accordingly the contractor should be made aware of the location and quantity of water available from approved existing points of supply in the contract documents. Nevertheless, prior to commencement of the contract the contractor shall submit an extraction programme to the MPWH for approval.

11.3 OFF SITE WORKS

Main Camp Location

It is assumed here that the possible alternative site locations that will be considered will either be in rural areas or on the periphery of existing urban development. Development of such sites within urban areas is considered acceptable only in established industrial estates with appropriate access control. In these circumstances, it is assumed that the camp will be subject

to the planning and operational controls established by the urban planning authorities. This case is therefore not discussed any further here.

The selection of the site for the camp will require considerable care and attention. In general terms the site should be located:

- with easy access to existing primary roads
- within easy access of the construction sites
- with ready access to existing infrastructure
- outside of known aquifer recharge zones
- at a site suitable for its future re use as a functioning development

Most of these issues are dealt with regard to specific issues below. In this context, therefore the most important aspect is the consideration of potential future use.

Since construction of the camp will foreclose the use of the site for other uses considerable opportunity costs will be incurred, and will continue to be incurred until the site is returned to its original state. Returning the site to its original condition is however, only one of many options available and may require considerable additional expenditure.

An alternative may be for the longer term utilisation of the camp, for other purposes, after the construction phase of the project, in this case the proposed Customs facility.

Wastewater Disposal

In general terms it is preferred that the camp is connected to an existing pipe borne sewage system, subject to the approval of the appropriate responsible agency. Approval in this context would relate to the volume of the waste and the existing capacity of the system and the suitability of the treatment and disposal system to handle the nature of waste anticipated.

If no connection to a suitable system is available as is likely to be case, self contained collection and disposal systems will be required. Prior to installation, the contractor should obtain approval for the type of system proposed. In this regard the suitability of the site should be investigated, with regard to the following factors:

- ground conditions, for example, for the use of septic tanks.
- relative location with respect to groundwater resources, in particular recharge zones.
- other factors considered relevant.

In addition, the Contractor should be required to submit to the MPWH, for approval, a proposed plan for the collection and disposal of the waste.

Depending on the requirements of the relevant government departments it may be considered necessary to install a separate system for the collection and disposal of industrial wastewater, which may be subject to a different collection and disposal plan.

Where possible the contractor should be encouraged to recover, treat and re use materials, in particular lubricants.

Accidental Spill and Leakage

Accidental spill and leakage of chemicals stored on could pose a serious potential threat to water resources and public health. Accordingly it is proposed that the contractor be required to submit to the MPWH an inventory of the materials to be stored on site, together with a preliminary indication of the quantities of material that may be present at any one time.

Clearly these indications of quantity will by necessity, be indicative only. The MPWH should, if necessary, consult with specialist units in government for advice on the precautionary measures to be taken in terms of both the planning and construction of the camp and the required procedures for the storage and handling of such material.

They should then inform the Contractor of these requirements. It is expected that these will include, at a minimum, specific operational requirements such as:

- definition of any materials to be isolated from each other
- use of proper protective clothing, equipment by employees
- proper handling techniques
- other safety requirements, ventilation, firefighting equipment
- etc.

However, depending on the advice of the specialist agencies, it may also include specific site design criteria, including measures to contain and isolate spills and leakages to specific areas through the use of hard stands, internal drainage and the construction of holding tanks[1].

Solid Waste

It is normal practise that a construction camp would be included in the existing municipal solid waste collection and disposal process. In their review of the materials to be stored on site, MPWH should notify the contractors of any solid waste materials expected to be generated that may require special handling and treatment and hence separation from other waste for collection and disposal.

If, however, it is not considered feasible or desirable to incorporate the site into established municipal waste collection systems, it may be possible for the contractor to sub contract (or if preferred carry out themselves) the collection and transport of materials to an approved landfill site. In such a case the contractor should submit a plan of collection procedures, frequency of collection, level of compaction, etc. to the executing authority for approval.

[1] In general terms and in all matters related to public health and safety it is preferred that the contractor submit a CASHES Plan for approval to MPWH.

Access

Mitigation of the impacts likely to accrue from construction traffic should take three forms:

- Access Control
- Road Cleaning
- Definition of approved access routes

Access control will require the restriction of turning movements to approved access points to and from existing highways and, if necessary, improvement to existing junction layouts to reduce the potential for accidents. It may also require restrictions on the timing of use, with construction traffic prohibited, outside of specified, supervised hours.

Prior to commencement of the contract the contractor should be required to submit to the executing authority a plan outlining:

(i) the location of proposed camp, entry and access points, and or points of access to the primary road network
(ii) additional traffic control measures required, e.g., temporary traffic lights or modified junction layouts
(iii) signage proposals
(iv) duration of use of proposed access points

Road cleaning measures will be required to ensure that the major road carriageway is kept in a safe condition, that surplus oil, mud and other materials are removed on a regular basis. As with access control the contractor will be required to submit a programme of road cleaning and signage for approval.

If wide or abnormal loads are required to be transported from a pre fabrication plant to the construction site they wherever possible be transported during the early hours of the morning. Appropriate times of operation would be between 2300 and 0500 hours.

With such loads it will also be necessary for specific obstruction clear routes to be defined with the co-operation of the police and other relevant authorities. These details, together with the proposed timings of the transport of abnormal loads should be contained within a plan submitted to the relevant authorities for approval.

11.3.3 RESOURCE CONSUMPTION

The mitigation requirements for heavy aggregate traffic are similar to those defined for camp construction traffic defined above, i.e.

- preparation of a plan for access points to and from major roads.
- preparation and adherence to a road cleaning programme
- preparation of a plan for access/ minor road use

Although it is noted above that the pre existence of the extraction and processing plants will considerably reduce the likely levels of environmental damage, the prevailing practises of the existing industries may be far from optimum. It may be possible, therefore, to use the project

to influence existing industries to improve their operational practises through incentive programmes. pre qualification criteria etc and the use of environmental audit processes..

In cases where local processing, ex of the extraction and primary processing plant, of raw materials, (e.g. crushing, washing) is anticipated the contractor should be obliged to ensure that wastewaters shall not enter streams, watercourses or other surfaces without control over discharge velocity.

It was indicated above that the contractor will be required to carry out damping down as an anti dust measure and that the sources of water for such measures shall be identified and an extraction and use plan prepared. Similar conditions will apply to the use of water resources for compaction of the road base.

11.4 PERMANENT IMPACTS

11.4.1 Productive Losses

Productive losses are not anticipated to be particularly high though wider, less tangible costs are not estimated. Given the extent of agricultural activity in the corridor there are no cases where it is possible to recommend the realignment of the Highway to avoid agricultural lands and remain within the corridor available.

Similarly, avoidance of the orchards within the defined corridor is rarely practical and would, in all cases, generate substantial additional disbenefits and costs. The only relevant mitigation for the land take is therefore compensation.

Assuming the optimum alignment is defined the only options left to mitigate the impacts of the Highway on the agricultural sector are:-

- Plot consolidation measures
- Compensatory Payments as outlined in the LARP.

11.4.2 Land Acquisition and Property Take

Relatively few buildings are taken by the project, and those that are taken are concentrated in three locations:

- On the ZTR where avoidance is unlikely to be possible. Simple, standardised, cash compensation procedures will be sufficient in this case though there may some additional complications with cash payments if the building is cooperatively owned. This is viewed as very unlikely.

- At the other two sites, (at kilometre of Section 1 and at kilometre of Section 2) it is possible that further reductions in the take could be achieved by minor adjustments to the proposed alignment during the final design stage. The two structures on Section 2, in particular appear to offer some potential but these are low cost structures that may be easily replaced at minimal cost. Therefore unless the design would be improved by the realignment or the inventory and census data indicate that the structures have a significance hitherto not evident compensation is probably the most appropriate option.

By far the most significant non residential structures are the stores of the Ministry of Supply. The ARR at this location is aligned below the Yajouz Road. This, in combination with the splay of Ramps 1 and 4 utilise a large proportion of the Government Grain Storage Area and affect the majority of storage facilities. The impact will be so extensive as to render the remaining buildings as operationally non-viable.

Preliminary discussions with the Ministry indicate that they would not object to relocation but that the replacement costs for the stores may be high. The discussions confirmed that there are no overriding reasons to keep the site where it is. It does not make use of the railway any longer, and most of the produce is hauled in by road from as far away as Aqaba and Saudi Arabia. In strategic terms, it would be better located on the national road network close to Zarqa but away from urban areas. The government authority responsible has a site available for relocation on which it already has some small units established.

There is at this time therefore no reason to believe that relocation would not be possible, provided the government departments agree on a strategy and cost.

11.4.3 Severance

(i) All Purpose Crossings

At this time, insufficient information is available to define precisely the nature and extent of the demand for pedestrian and vehicular linkages across and along the ARR. However, the following minimum programme of all purpose crossings is required.

(i) Guaranteed continued access to the Wadi Ush Road for all uses.
(ii) Provision of crossing for the village of Al Manakhir
(iii) Crossings to the north and south of the Muwaqqar highway.
(iv) Crossing from Dheybah to Sahab
(v) Crossing Dheybah to Luban
(vi) Two crossings linking the Shaffata area with Luban and Tunaib to the Desert Highway.
(vii) Relocation of the local access road on the ZTR.

(ii) Animal Crossings

Animal crossings will be required at selected locations on Section 2 though the exact location of these should be the subject of a specific consultation exercise to be undertaken during the design phase.

In addition it will be necessary to prevent animal egress to the alignment. It is recommended therefore that all Sections except the ZTR are fenced. If there are sufficient changes in level between the ARR and surrounding lands to create the required barrier fencing may not be required.

If fenced, considerable care must be taken in locating the fence within the terrain to ensure that the desired barrier effect is achieved. Location in relative local depressions for example may permit the more agile animals to easily jump the fence and thus gain entry to (and be trapped on) the Highway.

The issue of animal crossings should not be treated lightly. Experience throughout the world has shown that

In the case of individual properties alternative access will be required to be provided in each case. The routing of the access and type of provision should be determined following consultation with the respective property owners and a review of the nature of existing facilities. With regard to the latter it may be appropriate to provide upgraded facilities in cases where additional land take and journey length and times are incurred with the provision of the new access. In all cases the costs of new access provision should be borne by the executing authority.

(iii) Pedestrian Crossings and Control

To limit the potential for pedestrian - vehicle conflict along the alignment and at the proposed interchanges the design team should review the opportunities

11.4.4 Road Safety and Management

While the impact assessment suggests that the project will produce a positive impact on accident rates this does not preclude the requirement for mitigative action. Indeed, in most countries incorporation of the economic costs of accidents in social cost benefit analysis can be utilised to justify any number of additional road safety measures beyond those required by standard engineering practise.

In this regard attention is drawn to five possible additional safety features that may be provided

(i) Provision of emergency telephones and provision of barrier protection for individuals using emergency telephones

(ii) Additional pedestrian safety measures in the vicinity of the interchanges where ramps are at ground level.

This issue has been addressed previously but is sufficiently important to permit reiteration here.

(iii) a hazard warning system for the ARR

This would typically, be a centrally controlled variable multi message system, capable of warning drivers in advance of potential hazards, fog accidents etc., and providing advisory notices on speed restrictions etc. via an electronic signage system. However there is no need at this time for such sophisticated systems to be incorporated in to the project. A simple system of based on flashing amber and red lights that may be initialised locally by authorised personnel, police etc. would be sufficient.

(iv) provision of cross carriageway access for emergency vehicles.

The proposed road has six interchanges. However distances between interchanges on the main Sections 1 and 2 are quite lengthy and opportunities for 'authorised U' turns are, at best, severely restricted and, at worst, would require journeys in excess of 22 kilometres to an exit that provides access to emergency assistance. This is clearly unacceptable. Specific concerns in the event of an accident would include:

- life threatening delays in attendance to the wounded, during the first and most critical half hour after the event, by trained medical personnel.
- extended journey times for evacuating the seriously wounded to hospital.
- delays in the response time to the site of the police and other emergency services, with the consequent delay in controlling the scene of the accident.

It is essential therefore that access between carriageways for emergency traffic (emergency U turn facilities) is provided at appropriate distances, say every 3.5 kilometres. Such measures should take the form of surfaced crossings of the median. (Surfacing of the crossing permits immediate recognition by the emergency services). Any protection barriers in place should be of a design that permits easy disassembly by authorised personnel.

Of particular concern here is Section 2. Should there be a serious accident blocking an entire carriageway, or in the event of fog a series of accidents, on this section, no alternative route is available for emergency vehicles to access the accident site(s). In this context the maintenance of access of Wadi Ush road is critical and it is similarly important that access to the main highway is possible from the Manakhir road (for emergency vehicles only).

(v) Provision of police parking ramps. High visibility policing has proven to be one of the most successful means of reducing vehicle speeds and accident rates on new high speed roads. Parking ramps

- place police vehicles approve road level making them a highly visible and effective deterrent
- they facilitate easy access to and off the highway for police and reduce fuel wastage; and
- provide police with an appropriate location to park. Present police parking on the hard shoulders and elsewhere is inappropriate (probably illegal) and dangerous and sends the wrong message to other road users.

11.5 NOISE MITIGATION

11.5.1 General

The impact section identified a number of areas of the ARR that would according to WHO guidelines require the provision of noise attenuation measures.

It should be noted in considering the need for mitigation that the WHO standards are very rigorous and are not met by any of the major roads in the alternative ring road corridor and a decision to implement the noise mitigation measures put forward for this project, will have wider implications with regard to traffic noise and impact reduction in Amman for future projects. In particular it will highlight the need for fundamental policy decisions with regard to the determination of applicable standards and the preferred methods of mitigation.

11.5.2 Mitigation Options

Engineering Measures

Engineering measures are usually adopted in cases where substantial numbers of properties will gain benefit and they include screening, by earth embankments, walls (barriers) or landscaping, and use of sound reducing materials. Engineering measures may be used either in isolation or in combination.

(i) Embankments

Sculptured earth embankments provide substantial noise relief, frequently to levels in excess of 20 dBA. Clearly the extent of the attenuation will be a function of the height shape and the absorptive capacity of the embankment surface. However, embankments may be unsightly, create a physical barrier, and increase perceptions of levels severance, and are therefore usually only utilised when it is perceived as desirable to visually eliminate the highway, or as an integrated element of a landscaping scheme. Moreover they may require substantial additional land take.

(ii) Walls / Barriers

Walls of a minimum of 1.5 m height are frequently used for limited sections of expressway. Solid walls, depending on height may give an attenuation up to 20 dBA. They are however often unsightly and if used over extensive lengths, particularly at grade may induce substantial severance effects. Less visually unsightly materials are frequently used but these tend to offer significantly less attenuation.

(iii) Cover

More recently it has become common practise for urban highways to be placed in either cut and cover sections or when elevated, covered. In the latter case this type of mitigation is usually promoted when the structure is in the vicinity of multi storey buildings that can not be adequately protected by protective barriers.

(iv) Landscaped Barriers

Vegetation at a height of at least 5m above sound source and in strips of a minimum of 40m will provide noise attenuation of 5 - 10 dBA with the maximum value achieved only if the vegetation is sufficiently dense to eliminate any line of site between the source and the receptor.

(v) Porous Asphalt

The use of a porous asphalt surface may be considered. Test data from a number of countries has shown that noise attenuation of at least 3 dBA is achieved though as the data contained in Table 11.3. suggests greater attenuation may be achieved.

Research to date on porous pavements has suggested that over the long term, (> 10 years) significant reductions in noise attenuation and hydraulic properties may occur, primarily due to the clogging of the pore spaces, either by foreign matter or physical compression under heavy loads. There are four particular conditions under which these losses in performance are considered likely to occur.

- urban roads with slow moving but high traffic flows.
- urban roads with a high proportion of heavy traffic.
- roads that are subject to unusually heavy dirt loads, e.g. rural roads with a high volume of agricultural traffic.

Table 11.3 Results of Studies of Noise Attenuation from Porous Pavements

Source	Country	Attenuation dB(A)	Comments
Camomila, Malgorini and Gervasio	France	1 - 6 5 - 6	Thin pavement Thick pavement
TRRL	UK	4 - 5.5	Reduction in attenuation to 4dBA after 4 years on a road section with 7500 vpd per traffic lane and 45 % vehicles with unladen weight > 1.5 tons
Van Heystraeten and Moraux	Belgium	6 - 10 2 - 3	Compared to concrete surfaces. Other surfaces at 80 kph.
Iserring, Koster and Scazziga	Switzerland	3 - 7 0 - 4*	Compared to concrete surfaces Other surfaces
Riuz, Alborela, Perez and Sanchez	Spain	3 - 5	Further attenuation of upto 2 dBA in wet conditions.
Van der Zwan, Goeman, Gruis, Swart and Oldenburger	Netherlands	3 8	Standard vehicle test at 80 kph. Under wet conditions

Note * the low values returned in some cases in Switzerland reflect very poor winter results on low speed urban roads due to clogging of pores in the road surface
Source: As noted.

- roads that are subject to infrequent flushing or where the design, in particular the superelevation, is poor.

Relocation and Property Improvement

Relocation is only rarely considered, and usually only in cases where additional factors such as access severance, are also involved. Property improvement in the form of acoustic improvement of building facades (at the individual property level) is usually the preferred option being, less costly and usually more effective, though only when windows are kept closed.. However, where properties are within fifty metres, relocation may be considered, as an option available to the resident.

11.5.3 Specific Proposals

Discussion have taken place with the MAIA over the options available for ameliorating Project impacts at the mosque site. The view of the MAIA is that such disamenity will not be sufficient cause for the relocation of the facility. The argument being that the discomfort and disamenity values generated were largely irrelevant to the function of the building and the

needs of those at prayer. Exposure will in all cases be limited to 5 short periods a day of which at least two are during relatively low periods of activity.

In effect they made it clear that relocation would be far more problematic and was not a preferred option.

Schools

While the schools are not a source of extreme concern they will suffer adversely (particularly so in the future) and should be the subject of some attenuation measures. A five metre barrier is proposed.

Cemeteries

The cemeteries and the lands between them are government owned and this provides for an opportunity to establish an extensive and attractive landscaped area that will fulfil the dual benefit of noise attenuation and recreational development.

Two Seriously Affected Plots

The preferred option in these cases is a composite of bunds, planting and fences depending on the actual and final profile of the road and the land take required. If conditions combine to limit such options then fencing alone would be preferred.

New Developments

In the longer term specific proposals should be developed for the use of lands in areas of the ARR as follows:

(i) In cases of site redevelopment set backs from the road should be increased to the minimum limits[2] established below depending on the standards adopted:

Standard		**Distance**
60 dB(A)	WHO	200m
65 dB(A)	Transitional	85m
68 dB(A)	UK compensation guidelines	50m

(ii) New development in the first row of properties alongside the ARR should be restricted to non sensitive sites. Planning regulations should therefore be drawn up that specifically exclude schools, hospitals, libraries and kindergartens.

(iii) To reinforce the separation of the road from potential surrounding lands a transitional zone of tree -planting should be provided.

Table 11.4 presents a summary of the Mitigation proposals and Table 11.5 indicative attenuation.

[2] Minimum excluding attenuation measures.

11.6 AIR QUALITY

At the corridor level there is little that can be proposed to mitigate against vehicular produced air borne pollution at the project scale. Measures such as:

- introduction of regular vehicular testing
- incentive taxation policies for relatively non polluting vehicles
- tax incentives for the use of cleaner fuels
- promotion of higher vehicle occupancies by vehicle sharing,

are essentially national level policy decisions that are not of direct relevance to the project.

Table 11.4 Noise Mitigation Proposals

Location	Projected Noise Level L10 dB(A)	Proposals	Comments
Mosque		Barrier	Combined noise, air quality and amenity losses sufficient to recommend relocation. Open nature of structure and mitigate against use of insulation. Relative position of mosque to road (elevated structure) is such that impacts are already partly mitigated. Further relief may be expected by barrier wall
Cemeteries		Planting and Banks or raise wall	Designs for interchanges are not completed to even pre final stage therefore relative positions of roads and sites have been estimated for calculation purposes.
Properties		Planting and Bunds	If land is available. Alternatively fencing.
New Sites	Standard	Set Back or Regulated Insulation	Set back is preferred but insulation permissible.
		Buffer Planting	Where possible land owners should be offered free of charge the planting of appropriate trees species as a buffer between the ARR and development areas.
		Specified Use	Exclusion of specified sensitive urban land uses; schools, hospitals etc.
Redevelopment			As above

Table 11.5 Noise Attenuation Projected for Sensitive Sites

Receiver / Chainage (m)	Predicted unattenuated noise level		Guide-line	Proposed Measures	Estimated attenuation
	2003	2008			
Schools	63.4	65.9	60.0	Barrier 5 m	> 16
Mosque	60.0	62.4	60.0	Barrier 1.5 m	> 6
Cemeteries	67.7	69.8	50	Landscaping and earth protection	>15

Source: Consultants Estimates

In the local level assessment carried out only the mosque of the sites adversely affected by the ARR is projected to exceed the specified limits. In this case no defined mitigation is specified. The preferred option of relocation (from noise air quality and general disamenity

considerations) is viewed unfavourably by the MAIA who as noted above do not view the disamenity as a major concern.

11.7 ACCIDENTAL SPILLS

This section relates specifically to threat to the waters of KTR and the small and probably illegal reservoir built on Wadi Al Ush.

There are three basic options available to prevent or minimise the impacts of a spill.

(i) Catchment protection measures
(ii) Road Engineering
(iii) Other site aspecific measures including, driver training, vehicle inspections, driver inspections and the establishment of emergency procedures for implementation in the event of a spill.

(i) Catchment Protection Measures

In general terms, the drainage measures required to minimise the effects of accidental spills are similar to those required for normal highway run off. Additional catchment protection works, such as interceptor berms, designed to further protect impounded waters against accidental spills are not considered appropriate for the following reasons:

- the reservoir is a considerable distance from the proposed route and spill material would be unlikely to be rapidly and directly transmitted to the impoundment areas. In the periods of relatively high flow required to transmit the spill quickly to the reservoir, dilution rates for all but the most toxic of materials would be sufficient to rapidly reduce the potential threat of the hazard. It is also assumed in this regard that enhanced monitoring of water treatment processes and quality control at the distribution point will also be in effect in the event of a known spill. In times of low, discontinuous or zero flow percolation rates would be such that the material would enter the groundwater resources.(see below)

- unless similar measures are taken on other roads or traffic of potentially hazardous materials is confined to the ARR the threat is unlikely to be greatly diminished

- Two alternatives are available; to confine the works to roadside drainage channels or alternatively in both these channels and the main stream. The latter option would be hugely expensive and may have considerable adverse environmental impacts in their own right. However even assuming the measures were confined to the drainage channels they would be unlikely much more effective than the basic measures proposed. Such extreme engineering solutions should only be considered for very small closed catchments providing potable water that are considered to be under extraordinary threat.

(ii) Road Engineering

The combination of heavy trucks and long downgrades is a significant hazard to roadway users and in the case in point also a potential threat to the environment. On severe grades,

gearing down and using brakes plus the retarding power of the engine are sometimes insufficient to hold vehicles in check.

The problem of runaway trucks generally stems from brake failures, which can arise from a variety of causes. In the USA, defective or incorrectly adjusted braking systems on tractors or trailers, driver inexperience with equipment and the lack of or, unwarranted reliance, on retarder systems are viewed as the primary contributors to brake failure or overheating. In the specific case of Jordan with its hot summers, generally ageing truck fleet, and lack of specialist training for truck drivers, these problems will considerably accentuated.

The only measure available to prevent accidents caused by runaway trucks are truck escape ramps (TER). For existing roads, the dominant factor in the UK and the USA, in deciding on TER provision is the accident history of the road, with grade length, percent of grade and conditions at the end of grade weighing about equally. Unfortunately there is little data available on the criteria for the provision of TERs on new roads. The AASHTO "green book" for example, offers the following.

" where long descents exist or where topographic and locational controls require such grades on new alignments, the design and construction of an emergency escape ramp at an appropriate location is desirable for the purpose of slowing and stopping an out of control vehicle away from the main traffic stream. Specific guidelines for the design of escape ramps are lacking at this time".

It appears that there are sufficient variables in each case to warrant independent assessments of the need for a TER.

The conclusion of this study is that, in the event that a two lane carriageway is proposed for the descents in the vicinity of Wadi Ush serious consideration should be given to the options available for the provision of an emergency stopping lane at an appropriate location. This will, in particular, apply to lengths of Section 2 where:

- between km 13+160 and 14+000, grades exceed 6.5% with a 450m horizontal curve at the bottom of the gradient
- continuous grades of 4% or greater are proposed for 5.3 kilometres, with a 4.5 km section at 6%.
- vehicles may approach the descent at relatively high speeds, 60 kph or more.
- the terrain offers no natural alternative to a TER

Accordingly it is recommended that a TER is provided if a suitable site can be defined and an appropriate engineering configuration can be built at reasonable cost.

A review of available literature on the criteria for the location of TERs indicates that similar weaknesses to that on the criteria for the provision of TERs, are evident. The dominant factors are, the desirable speed at entry, and distance from the top of the grade. While general consensus on the desirable maximum entry speed is evident, at between 125 and 140 kph, localised factors such as ability to negotiate bends prior to optimum location site and terrain or availability of ROW, militate against the use of standardised formulae. The actual location and length of the TER should be the subject of a detailed engineering study.

There is however consensus on the nature of the TER. They should take the form of flat, or preferably, inclined sections laid with speed retarding materials, preferably rounded aggregate graded in the size range of 1.25 to 1.8 cm (0.5 to 0.7 inches) to a depth of 1 - 1.5 m. The length of the lanes will be a function of the assumed maximum entry speed and weight of the design vehicle. Moreover to be effective TERs must be readily accessible to vehicles under poor control, (i.e. tapered entry with wide access points), clearly identifiable, and with adequate advance notification of their availability. Accordingly considerable care will be required in the attention to such detail in the final design.

(iii) Site Aspecific measures

There are a number of other non engineering related measures which may be implemented to reduce the threat of accidental spills and also improve overall road safety. Combined together these may take the form of a three element programme:

- Hazardous Load notification and Vehicular inspection

In this discussion it is necessary to differentiate between hazardous loads and non hazardous, but potentially polluting loads.

The policy on the notification of hazardous load transport in Jordan is unclear, but is not believed to be effective although some vehicles it is understood that most vehicles carrying hazardous materials are marked using internationally recognised symbols.

Routine vehicular inspections particularly of heavy trucks and trucks carrying hazardous materials should be implemented along the ARR and at the Customs facility. These checks should pay particular attention to brake condition and should also include a briefing for the drivers on the availability of the TER and advice on its use. It has been found in the USA that driver reluctance to use the available facilities has led to a number of preventable accidents. The issues behind this reluctance are both psychological and financial and can only be addressed by informational and educational activities.

- driver condition and training

Occasional checks on driver condition should be introduced. Clearly it is preferred in the case of load and driver inspection that any measures undertaken are not viewed negatively by transporters, since this may heighten the threat to the reservoirs by causing operators to elect to use the inferior and potentially far more threatening Zarqa Highway. In this context it is recommended that a consultation exercise is undertaken with the major operators to inform them of the programme and its purpose. This may be most easily done in the context of a national programme designed to create a data base on the transport of hazardous materials in Jordan.

- Development of Emergency Diagnostic Response Programme

In addition to the measures proposed above it will be necessary to develop an emergency diagnostic response programme in the event of a spill which will have as its priority.

- definition of the quantity and type of spilt material
- definition of any immediate hazard to road users and neighbouring residents
- definition of appropriate site clean up measures and materials to be used.
- issuance of notifications to water authorities of the volume and nature of the spill
- where necessary, direct communication to land users and water resource users, of the potential hazards caused by the spill and advice on likely duration of the adverse effects.

This programme would best be implemented by specially trained teams established from within the ranks of the emergency services. Their primary role would not be in the actual clear up of the spill but the diagnosis of the potential threat and the co-ordination of the implementation of countermeasures within the framework of an established response procedure. They would require access to specialist scientific support, available on a 24 hourly basis.

11.8 ENVIRONMENTAL ENHANCEMENT MEASURES

Direct environmental enhancement measures are provided by a programme of landscaping developed at four levels within an overall structure, Appendix M

(i) Creation of a sub regional Recreation Area; Large scale planting and development. To include picnic areas, children's' play facilities, parking and extensive landscaping. Preferably on Section 2.

(ii) Noise Attenuation Planting: Localised dense planting to supplement barrier effects of land sculpting and earth banks at cemetery site at sites indicated previously.

(iii) Buffer Zone Planting: On Section 1 at selected locations to define clear buffer zone between potential development sites and the ARR. May also provide some noise attenuation.

(iv) Shelter Belt Planting; predominantly along Section 1.

In total some 42,000 trees have been costed into the mitigation programme.

Elsewhere opportunities for direct action are limited primarily by the weaknesses in the Planning system.

11.9 MAINTENANCE

11.9.1 Landscape Maintenance

The only possible cause for concern in the maintenance of landscaped areas would be the use of chemicals, either fertilisers, or pesticides and herbicides. Accordingly, the threat to natural systems is likely to be minimal, assuming that any chemical use is appropriate and undertaken in a well controlled manner. Some, equally limited threat, to the health of users of any landscaped area could also exist.

It will be necessary therefore for a specific plan for the site to be developed that ensures that visiting populations are not exposed to high levels of chemical dosage. Similarly, the site

managers should establish effective material handling, storage and use mechanisms and train staff properly in their application. Such recommendations should be reinforced with the threat of environmental audits of all facilities and practices utilised in the maintenance programme.

11.9.2 Highway Maintenance

The primary sources of any potentially adverse impact from highway maintenance operations are:

- waste material disposal

In this case the primary concern will be the solid waste generated from drain clearance operations. This material is likely to be relatively heavily contaminated and should appropriate pre planned disposal procedures should be put in place.

- accidents

Two types of accidents may occur:

- those involving maintenance staff
- those resulting from traffic flow modifications generated by maintenance activities.

The potential significance of these impacts will be a direct function of the quality of the preparatory planning works carried out, the effectiveness of advance warning signs and the quality of the on site supervision. Though the ARR will pose specific problems to those responsible for maintenance operations these can be easily overcome and there is no reason to believe that the potential risk of any accident should be any greater than other roads.

11.10 INDUCED DEVELOPMENT

11.10.1 Planning Framework

Clearly much of the above is a matter for wider consideration than just this project and many may consider this EA an inappropriate place for recommendations on the matter. However, there is a need for the ARR Project to support and be supported by land use planning if the anticipated indirect impacts are to be effectively managed. Put in another context, the ARR will provide both a spur to development that needs to be managed and also the beginnings of a structure onto which a land use plan can be grafted.

The principal concerns identified earlier are further reviewed below and from this it is apparent that existing structures and systems will by and large allow for the required planning control.

Issue	Comments
Lack of Regional Plan	
(i) Lack of Physical Framework	With local area planning this may not be an issue provided broad land use concepts can be developed or derived from past studies
(ii) Lack of policy framework	Is required if a consistent / coherent Plan is to be prepared.
Overlapping Administrative Domains and Spatial overlaps	At least three levels of planning unit may be involved. This can be facilitated.
Weaknesses in Planning Legislation	
(i) Absence of Phasing and lack of mechanism in legislative texts for controlling the implementation of phasing proposals	Legislation requires programming and implementation phasing is built into land use plans but rarely included in past approved plans and not implemented.
(iii) Development of plot may occur at owners leisure.	Makes it difficult to delay development where the timetable for infrastructure provision does not provide for facilities in the short term. These are the main failings of the system as they call the whole planning process into disrepute and promote ad hoc development.
(iii) Lack of supervision capabilities amongst local planning authorities.	There is effectively no control over the development process a problem that will need to be addressed in the future.
(iv) Limited opportunity for public participation in setting standards and contributing to the planning of the local environment.	Participation limited to the submission of objections to aspects of a plan. This may be easily overcome.

Based on this premise the strategy proposed is to reinforce the Middle Region Planning Concept but to adjust areas of emphasis and activity to promote the development of a more responsive planning process.

(i) Change emphasis of the MRP effort to the production of a Structure Plan; i.e. development of policies and general patterns of activity

The Planning works completed to date by the MRP should be subject to extensive review and consultation and developed into a Regional Structure Plan and a set of Regional Policies.

(ii) Establish clear time frames for Regional Structure Plan formulation.

It will be necessary to have in place clear and definitive policies for development planning prior to project opening in 2003 and preferably far earlier.

(iii) Promote localised Planning within Structure Plan concept.

Within this framework a local area planning approach may be developed that facilitates local consultation regional and responds more quickly to changing circumstance. Appropriate review processes will however be required to ensure that integrity of the Regional Structure Plan is maintained.

(iv) Develop consultative framework

The new plans (Regional and local) should be published for public comment and approved only after an extensive consultation programme.

(v) Facilitate the development of interim plans prior to completion of RSP

Such a programme may be implemented under the powers available in the **Compulsory Planning** regulations whereby a local council may, with the approval of the regional council, proceed to produce a new plan for areas defined.

"This new plan may annul existing property rights and allocate new plots to former owners as close as possible to their original plots. A proportion of the land area may be withheld to allow for road construction or other public uses, in accordance with the provisions of the law of expropriation and the law for parcellation planning. The new plans, with plot descriptions and allocation, must be forwarded to the Land Registry".

The timeframe for these works is limited. While the likely overall change in land use and activity patterns between construction start and completion in the first few years may be limited the precedents set by 'pioneer' development sites will be difficult to overcome in subsequent years. It is important therefore that plans are developed relatively quickly at least for the corridor in the immediate vicinity of the road and regulations are applied immediately.

(vi) Implementation

Support for the new Plan must also be available through the enforcement of planning and building regulations and any special conditions which apply. Development must be in accordance with the approved land use as shown on the master or detailed plan.

There are however two areas of remaining concern:

- Absence of a mechanism for controlling or enforcing the implementation of Phasing controls and the associated expectations of the people for service provision.

- Means of enforcement: Responsibility for enforcement of planning regulations lies, quite appropriately, with local authorities. Unfortunately in most cases these have neither the means or the will to enforce the regulations.

11.10.2 Road User Preferences

It is clear that the only way to determine road user preferences will be to ask them. Accordingly, it is proposed that surveys of truck drivers and owners are carried out to identify their specific needs and wants. These surveys need not be undertaken on the road but could be carried out at the offices of haulage companies and transport unions as well as in other areas frequented by hauliers from outside Jordan. This survey should be undertaken as an adjunct to or as part of the detailed design.

Should it become apparent that facilities are required a further more detailed exercise should be undertaken that seeks to identify the preferred location, facilities required, their design and

cost. MPWH may wish to further investigate the potential for financing them and or gaining revenue from the private sector on a leasing, concession, etc. basis.

It is important to reiterate here however that the road users are consulted in the development of these facilities at all stages of there planning.

11.10.3 Local Area Traffic

A study should be undertaken to simulate traffic flows in the vicinity of the ZTR to identify a preferred local area traffic management plan. If desired this plan may incorporate an element of longer term planning to identify the preferred alignment and associated local area traffic management plan for the extension of the ZTR clear of the urban area.

11.10.4 Interchange Planning

The issues of public transport activities and uncontrolled pedestrian movement at either end of the highway will need to be addressed through specific local area development plans designed to ensure that inappropriate land uses are excluded from the areas surrounding the interchanges. In addition consideration may be given to special policing of the interchange areas.

11.11 CRMP

Preventative works carried out during the Design Phase of the Project will comprise the main element of the CR Mitigation Programme.

At this time each of the defined 23 threatened sites should be subject to individual study, though the extent of the survey will vary in each case depending on the recommendations of the CRM archaeologist. In general the works will comprise:

- Intensive Survey — Minimum Option
- Test Trenches
- Limited excavation — Maximum Option Mitigation Plan Proposal
- Full excavation: — Possible further stage.

An interactive design review between CRM and the Design Consultants is also proposed for each threatened site. The MPWH and DAJ shall on the basis of the findings of this review define the preferred mitigation option.

In addition, once the final alignment has been fixed and the extent of any earthworks and borrow pits is known, sites that remain classified as not threatened should be revisited and fully documented for record purposes.

Three sites, believed to be Bedou cemeteries should be the subject of co-ordination with the MAIA and affected communities on possible treatment options.

Two other, institutional support related, measures are proposed. The cultural resource assessment process is still immature and lacks the necessary structure of checks and balances. It is proposed therefore, that the mitigation proposals of the design team (design review study

and the further assessment of threatened works) are the focus of a workshop(s) at which they will be subject to thorough review by appropriate peer groups. Secondly, it is proposed that the ARR is utilised for the initial development of a framework to define and classify the values of the threatened sites in a manner that allows for the framing of appropriate development and construction guidelines that may be applicable elsewhere.

A very important regional site, Qasr Al Madhuna will be indirectly threatened by the project and will need to be protected. Further evaluation studies and subsequently, physical protection from a perimeter fence are proposed.

In the Tender Phase, prequalified contractors will be called to a Pre-tender conference at which issues of special interest or concern will be outlined. To support the stipulations of the pre tender conference, contract bid documents will include a set of final engineering drawings on which archaeological sites within or immediately adjacent to the construction area are defined.

Construction Monitoring will be required to ensure compliance with applicable guidelines, regulations and statutes, and contract specifications. Two forms of inspection will be required; (i) event specific, pre-programmed to particular events such as the opening and demarcation of a borrow areas; and (ii) Random Inspections. Any additional monitoring that may arise from chance finds or additional excavations will be the subject of specific agreements with the MPWH.

An end of project report shall be prepared by the CRM team. The proposed CRIA monitoring will be undertaken by the CRM unit of DAJ The principal reporting mechanism of the CRIA monitoring programme will be an end of Project workshop. Interim reports on activities carried out will be prepared on a six monthly basis.

11.12 LARP

The Project is committed to providing entitlement to persons who lose their land or other property as well as to others whose livelihood is directly affected by the acquisition of land. The existing provisions of Jordanian law however only apply specifically to the acquisition of land. There are numerous other assets and cases (viz. loss of work, loss of income) to which the law does not provide specific entitlements though such entitlements are warranted.

Accordingly, the entitlements of the existing law have been supplemented by additional benefits and benefit options and by significantly improving the compensation offered under the few existing guidelines that do exist (primarily for agricultural product). The additional benefit options include entitlements for vocational training, work opportunities, in addition to provisions for greater use of non cash compensation options for land.

The principal form of compensation will be cash which will normally be available at asset replacement cost, in lieu of lost income, or for costs incurred. Land may be offered as a straight land swap, as part of a consolidation programme or in lieu of cash compensation.

Employment opportunities provided under the Project will consist of priority in project employment on the basis of an employment permit system. Women and minors entitled to a work permit will be permitted to nominate an alternate person to receive the work permit.

Except for these categories, permit-holders will not be able to transfer or sell their permits. Access to such services as training, may be available on a priority basis if the PAP so desires.

At this stage no packages have been allocated to a specific PAP. Therefore all the options considered are to a degree theoretical. They have however been the subject of discussion and debate in affected areas and ultimately it may be that in negotiations the strength of the desire for cash payments in all cases will simplify the process.

In determining entitlements, the purpose will be to identify category of loss rather than category of person affected, as some Project Affected Persons (PAPs) will suffer more than one loss.

All PAPs losing irrigated and rainfed land will be entitled to cash compensation. If the area lost exceeds 25% they will also be entitled to land options. Cash compensation will be based on the assessed market value. Stamp duty and other taxes on land registration and land transfer will be paid by MPWH, if it is not waived by Government.

Landowners losing their entire land to the Project and who have no other sources of income will be given priority work permits as well as priority access to training and employment opportunities. Agricultural infrastructure (wells, internal access roads, walls, farm buildings, etc.) will be compensated at full replacement value.

To minimise the period during which PAPs will be deprived of agricultural income, they will be permitted to farm the land, even after MPWH has taken possession, until the land is required for construction.

All PAPs losing uncultivable land will be entitled to cash compensation. The owner of a house will be entitled to cash compensation at replacement cost. If a tenant is resident the they will be provided with cash compensation to a maximum of 5% of the total compensation package offered for the property. Salvage rights of housing materials will be available to the owner of the dwelling structure.

Illegal occupants will be entitled to compensation for any structures or improvements made to the land that are more than 1 year old.

Fragmentation of Landholding: A PAP losing part of a continuous landholding, where the residual fragment is smaller than 0.1ha, will be entitled to have the residual fragment also acquired. A PAP losing part of a landholding, where the residual landholding is adversely affected by severance, will be compensated appropriately following negotiation. A PAP losing part of a landholding, where the residual landholding is deemed unsuited for its previous use, or too expensive to return to a state in which its previous use can be maintained, will be compensated appropriately, following negotiation.

If, as a result of land acquisition, a PAP is compelled to change his residence or place of business, they will be compensated for reasonable expenses incurred in undertaking such change.

Any tenant farmer with a legally-valid tenancy will be entitled to a part of the cash compensation payable for the land and to compensation for any land improvements they have

made, in accordance with the provisions of the Laws of Jordan, and the terms of the tenancy. Cash compensation will also be due in proportion for any standing crops, orchards and other trees will receive cash compensation for these assets. Informal tenants will be entitled to compensation for any land improvements they have made and will be provided with work permits and priority access to credit and training.

Anyone who loses employment (resident agricultural labourers and family labourers) as a result of the Project will be given work permits and priority access to Project training schemes. Seasonal labourers determined to be significantly impacted by the land acquisition will also be eligible for work permits and given access to Project training schemes.

One of the principles of the LARP is to provide support to PAPs during the transition period to ensure that the standard of living of PAPs is not adversely affected. To achieve this, the following measures are adopted:

- Losers of cultivable land will be entitled to cash compensation for a period of up to 3 years, or until they are able to restore their income to former levels.
- In order to minimise the period during which PAPs will be deprived of agricultural income, they will be permitted to farm the land, until it is required for construction, (even after MPWH has taken possession).
- Work opportunities will be provided under the Project primarily through employment with the Contractors through the issuance of work permits.

SECTION 12:

MONITORING PLAN AND INSTITUTIONAL STRENGTHENING

SECTION 12: MONITORING PLAN AND INSTITUTIONAL STRENGTHENING

12.1 INTRODUCTION

This section outlines the proposed Monitoring Plan (EMP) for the First Phase of the ARR. The Monitoring Plan comprises five elements each described in a sub section as follows:

- Site Inspections: to cover the day to day monitoring of construction activities and sites and occasional inspections of sites under operational conditions as appropriate, Section 12.3.
- Environmental Audits; Of on and off site facilities, Section 12.4.
- Environmental Monitoring; Quantitative assessment of project actions and operations, Section 12.5.
- Cultural Resource Impact and LARP Monitoring, Section 12.6

Each section outlines the resources required to undertake the proposed programme of works and the preferred implementation structure and division of responsibility. Section 12.7 outlines proposals for capacity development and training.

These discussions are preceded in Section 12.2 by a brief outline of the standards adopted for Project monitoring.

12.2 ENVIRONMENTAL STANDARDS

No norms or standards that may be directly applicable to this project have been approved by GCEP. Accordingly, all the environmental standards employed in this assessment are internationally accepted norms prepared by the EU, WB, WHO etc or interim standards adopted by countries of a similar development status to Jordan. In this case the standards of Malaysia are applied.

Ambient Air Quality Standards

Malaysian Guidelines				
Pollutant	Averaging Time	(ppm)	(ug/m3)	Target Year for Compliance
Carbon Monoxide	1 hour	30	34 mg/m3	1995
	8 hour	9	10 mg / m3	
Nitrogen Dioxide	1 hour	0.17	320	1990
European Community Air Standards				
Pollutant	Regulation	Type	Period	Value
Nitrogen Dioxide	85/203/EEC	Limit Value	98th percentile of yearly mean hourly concentration	200 ug/m3
		Guide Value	ditto	135 ug/m3
		Guide Value	50th percentile of etc.	50 ug/m3
Carbon Monoxide	85/203/EEC	Limit Value	8 hour	9 ppm

Source: DOE and UK Dept of Transport, 1994 Recommended Malaysian Guidelines (JAS 1989)

Ambient Noise Standards: dB(A)

Category	Day dB(A)	Night dB(A)
Residential	55	45
Commercial	65	55
Industrial	75	70

Source: Health and Safety Guidelines - World Bank

Construction Equipment Noise Limitation and Vibration

Activity	Source	Limitation Day	Night
Earthwork	bulldozer excavator	75	55
Pile	piling machinery	85	none
Structure	concrete mixer / concrete pump	70	55
Surfacing	Roller	70	55

Source: Malaysian Guidelines, JAS 1989

Category of Vehicle	Maximum Sound Level Permitted (dBA)
Used for the carriage of goods. Permitted maximum weight does not exceed 3.5 tons. Engine is less than 200 hp DIN	81
Used for the carriage of goods. Permitted maximum weight exceeds 3.5 tons. Engine is less than 200 hp DIN	86
Used for the carriage of goods. Permitted maximum weight does not exceed 3.5 tons. Engine is 200 hp DIN or more.	88

Source: Malaysian Guidelines, JAS 1989

Dust /Other Emissions by Concrete Plant and Bituminous Mixing Plant

Source	Standard A gm/Nm3	Standard B gm/Nm3	Standard C gm/Nm3
Stationary Plant	0.5	0.4	0.3
Mobile Plant	0.7	0.7	0.4

where: a mobile plant is defined as plant that operates for a period not exceeding 24 months and which has a rated production capacity not exceeding 60 ton per hour. Standard C is applicable to all new premises or facilities.
Source: Malaysian Guidelines, JAS 1989

12.3 SITE INSPECTIONS

12.3.1 Objectives

Site Inspections will provide day to day monitoring of construction activities and sites and will include occasional inspections of sites under operational conditions as appropriate. They will provide the mechanism by which contractor performance, and at a later date system operators, compliance with applicable guidelines, regulations and statutes can be assessed.

12.3.2 Access Requirement

For the proposed programme (both site inspections and monitoring) to be effective it will be necessary, during the course of construction and operation, for authorised agents from key agencies, (PIU, MPWH, DAJ, GCEP) to have guaranteed access to all sites, related to

any project component, at all times. Accordingly, contract documents and operating agreements should incorporate a phrase with similar intent to that outlined below.

Any officer authorised in writing by PIU, MPWH, DAJ or GCEP may at any time enter any premises whether prescribed or otherwise and may:

- *Examine and inspect equipment, control equipment, monitoring equipment or plant;*
- *Take samples of any pollutants that are emitted, discharged or deposited or are likely to be or are of a class or kind that are usually emitted, discharged or deposited from such premises;*
- *Examine any books, records or documents relating to the performance or use of such equipment, control equipment, monitoring equipment or plant or relating to the emission, discharge or deposit from such premises;*
- *Photograph such premises as he considers necessary or make copies of any book, records or documents seen in the course of such examination.*

For this project an Environmental Liaison Officer (ELO) with a thorough knowledge of site conditions should be appointed to the PIU. Until the project completion report is finalised (in this case the last project completion report of the last contract) the ELO will have the responsibility to liaise with all parties involved in the design and construction of project works, especially the design team and supervisory engineering team and advise as necessary on all environmental matters, particularly those relating to the compliance or otherwise with relevant national and authority guidelines and policies.

12.3.3 Programme

Site inspections should be carried out on a regular basis but not necessarily to a structured pattern. However, during construction, the minimum programme shown in Table 12.1 should be observed.

Table 12.1: Suggested Minimum Frequency of Site Inspections During the Construction Phase

Principal Activity	No. of Inspections[1] per annum
Site clearance	12
General Activity	9
Batching Plants/ Asphalt Plants etc	12
Camp/ Maintenance Facility	6

To facilitate inspections a checklist of items to be considered similar to that provided in Appendix N should be drawn up. The checklist should be distributed to all parties concerned with construction who should also receive a briefing by the project ELO prior to initiation of construction works.

During operations all the major facilities associated with a project (e.g. maintenance yard, chemical storage site, and administrative centres) should be inspected, at least once every twelve months.

[1] The number of inspections defined refers to the total number to be undertaken in any one year period covering all project components.

12.3.4 Reporting

After each inspection during the construction phase, a report shall be compiled that is location and activity specific, and which identifies areas of contractor non compliance with the MP and which provides guiding remarks on the actions to be taken. The significance of the non compliance shall also be noted. Copies of these reports shall be sent to the Head of the PIU, GCEP and other relevant government agencies, the supervising engineer and the contractors for their action.

Every six months the inspection reports shall be compiled into a review document that should highlight any areas of persistent non compliance or negligence by the contractor. This document should also contain records of any communications between the supervising engineer, ELO and contractors on matters relating to the environment.

12.3.5 Responsibilities

Depending, on the extent of operations ongoing at any one time the ELO should be assisted by either one or two inspectors.

The ELO should be responsible for the preparation of all site inspection reports and should report directly to the Head of the PIU.

The finance for the day to day operations of the ELO and staff (excluding salaries) should be derived from an environmental management fee charged to each contract and payable directly to an environment account. This account shall be managed by the ELO according to the disbursement conditions in force at the PIU. Salaries and start up costs should be incorporated within the PIU budget.

12.3.6 Costs

The basic costs for these works include those for the establishment of the ELO and are as follows:

Item	Unit	Unit rate (JD)	Quantity	Cost (JD)
Labour	ELO		1	8000
	Inspector	5500	2	11000
	Driver	2100	2	4200
	Assistant	3250	1	3250
Vehicles	Supplied by Contractor			
Vehicle Operation	Supplied by Contractor			
Computer Equip	2 processor 1 printer		Lump sum	5000
Production Materials			Lump sum	12500
Office Space			at MPWH On Site by Contractor	
Total				**43,950**

Taken over a four year construction period and assuming continued extensive inspections throughout that time an overall budget of JD 120,000 is required.

Year	Unit	Cost (JD)
Year 1	EL Staff	11,250
	Establish EL Office	17,500
	Inspections (half year)	7,500
Total		36,250
Year 2	EL Staff	11,250
	EL office	5,000
	Inspections	15,200
Total		31,450
Year 3	EL Staff	11,250
	EL office	5,000
	Inspections	15,200
Total		31,450
Year 4	EL Staff	11,250
	EL Office	2,500
	Inspections (half year)	7,500
Total		21,250
Grand Total		**120,400**

12.4 ENVIRONMENTAL AUDITING

12.4.1 Objectives

The proposed audit programme is targeted at those project activities / areas of activity that are perceived as posing the highest environmental/public health risk. The audit programme has the responsibility to:-

- examine compliance with regulatory requirements
- examine line management systems, plant operations, monitoring practices etc.
- identify current and potential environmental problems especially during the operational phase of the project
- check the predictions in the EIA and assure the implementations and application of recommended practices and procedures.
- make recommendation for the improvement of the management system of the operation.

12.4.2 Frequency

At least one audit should be carried out for every major facility in operation during the construction phase. This is expected to include, main construction camp(s) and any on site processing and storage facilities such as those below:

- Operations and maintenance yards including, batching plants, asphalt plants, crushing plants and prefabrication yards
- Water abstraction points,
- Project Offices and camps.

12.4.3 Reporting

Reports should be prepared following each audit and circulated to the GCEP and site owners and operators. The reports should comprise.

- Background data; time, facility, operations underway etc.
- Statement of Findings of the Audit.
- Statement of compliance with the recommendations of the previous audit, (Where the audit is subsequent to an earlier audit)
- Recommendations for future action.

12.4.4 Responsibility

The ELO will have responsibility for environmental audits which should be contracted out to responsible agencies, or individuals, on a commercial basis. Independent reports will be prepared as part of the contract. The ELO will incorporate the findings of the audits in six monthly inspection reports noted above.

12.4.5 Costs

Given that each site will be developed from new and that audits may be undertaken prior to operations each audit should be a straightforward exercise that should take no more than one day to complete. Accordingly, the following man day inputs may be assumed:

15 sites @ 1 day per site
3 sites random audit
=18 days per annum.

Reporting 30 days (inclusive of sample testing and production cost)

Total cost per annum = 48 days @ JD 125 = JD 6,000

12.5 ENVIRONMENTAL QUALITY MONITORING

While preceding sections have outlined the mitigation and abatement measures to be adopted to minimise potential negative environmental impacts during construction, the potential success or failure of these measures can only be determined if an appropriate, associated monitoring programme is also undertaken. Typically, such a programme would be intended to:

- monitor alterations in existing physical, chemical, biological and social characteristics of the environment.
- determine whether any detected changes in environmental components are caused by the project or natural occurrences.
- determine the impacts of non compliance with project EIA and MP requirements by contractors, in particular to monitor emissions and discharges and ensure compliance with local, national and international standards.
- determine the effectiveness of the ameliorating measures in place.

- highlight areas of concern unforeseen in the EIA and MP and provide a basis for recommending further amelioration measures.

12.5.1 Programme Content

(i) Complaint based

Such works may include complaints of excessive dust, pollution of waters in a well, excess noise etc. Clearly the nature and extent of this programme can not be determined at this time but a 10% contingency is applied to the overall programme to accommodate these additional works.

(ii) Fixed Site Sampling: Construction

The fixed sampling programme will monitor **noise, vibration and air quality** in the construction period (4 years). No water quality monitoring is proposed for the corridor. However this may be reviewed if off site facilities are located in a hydrologically sensitive area though this is considered to most unlikely. A total of six sites is proposed:

- Cemeteries
- Mosque
- Zarqa Highway (x2)
- 2 others to be determined.

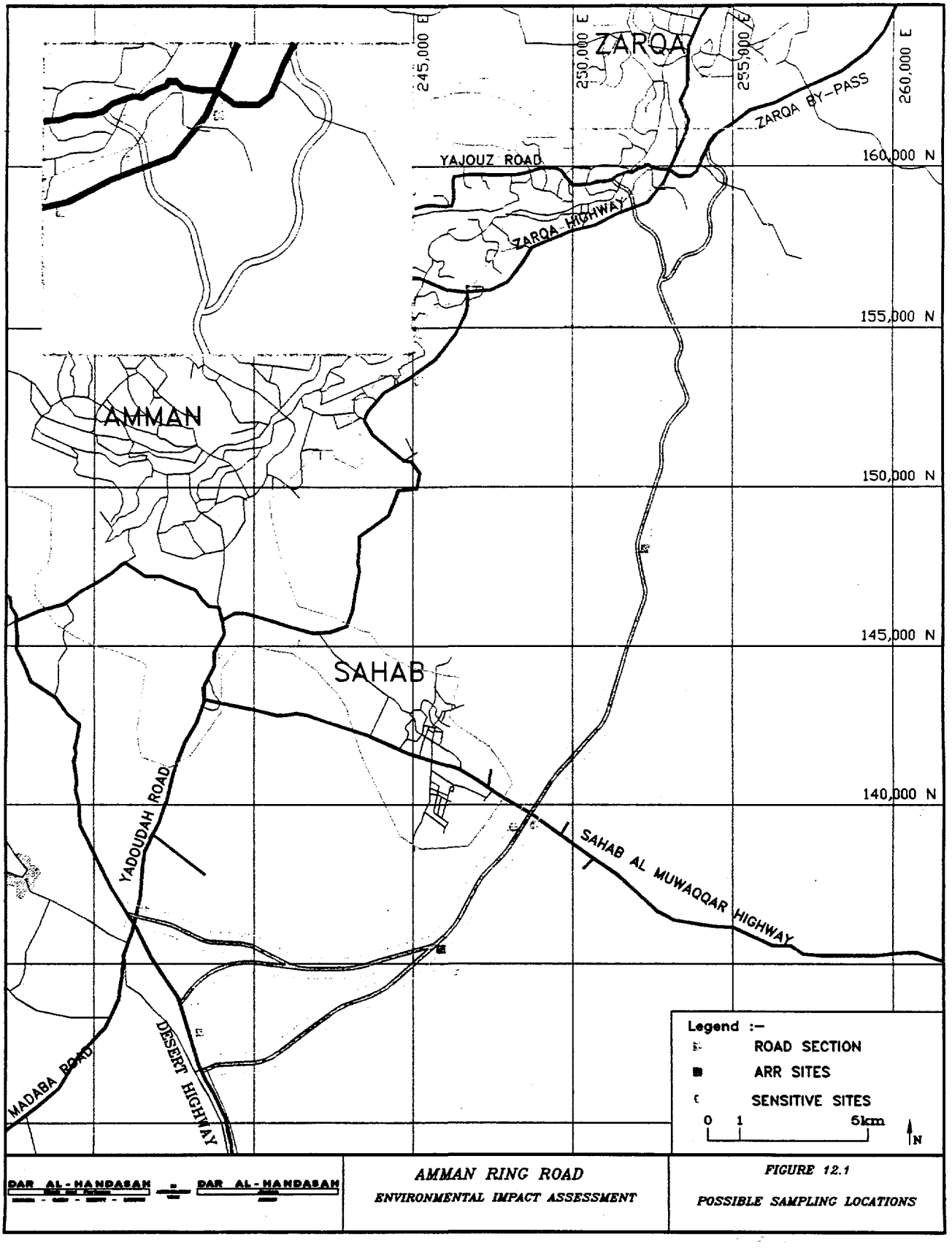
(iii) Fixed Site Sampling: Post Construction / Operations

A post construction monitoring programme will be required to measure the impacts of the Project over a period of at least two years after construction completion. In its narrowest form, this programme would need to be maintained with the following objectives in mind:

- to monitor alterations in existing physical, chemical, biological and social characteristics of the environment.
- to determine whether any detected changes in environmental components are caused by the programme or natural occurrences.
- to monitor emissions and discharges and ensure compliance with local, national and international standards.
- to determine the effectiveness of the ameliorating measures.
- to provide early warning of any potentially serious problems
- to measure long term impacts

It may also be expanded to form the nucleus of a environmental baseline survey for the Amman Region. A set of 15 possible sampling locations for this programme are defined on Figure 12.1 and listed below.

- Seven sensitive sites defined in the project Impacts Section, namely:
  - The Al Usra University
  - Zarqa College



AMMAN RING ROAD

ENVIRONMENTAL IMPACT ASSESSMENT

FIGURE 12.1

POSSIBLE SAMPLING LOCATIONS

- Zarqa Residential Area
- Cemeteries
- Mosque
- Hotel
- Zarqa Schools

- Six sites on existing highways that are projected to gain substantial relief from the project:

- Desert Highway
- Yadoudah Road
- Sahab Road
- Hizam Road
- Zarqa Highway (x2)

- Two other sites located on the ARR

- Mid Section 1
- ZEBP at the Military Complex

12.5.2 Sampling Frequency

A summary of the proposed sampling programme for the Construction and Post construction periods is outlined in Table 12.2

Table 12.2 Summary of Proposed Sampling Programme Frequency: Construction

Parameter	Unit	Frequency	Duration	No. of Sites
TSP	-	1 day / quarter	24 hour period	4
Dust	-	2 day / quarter	24 hour period	4
NO_X	-	7 day / quarter	1 sample / 4 hrs	3
CO	-	7 day / quarter	1 sample / 4 hrs	3
Noise	Leq	5 day / quarter	0600-2200	5
Vibration	VL_{210}	5 day / quarter	0600-2200	3

Summary of Proposed Sampling Programme Frequency: Operations

Parameter	Unit	Frequency	Duration	No. of Sites
TSP	-	1 day / quarter	24 hour period	5
NO_X	-	7 day / quarter	1 sample / 4 hrs	8
CO	-	7 day / quarter	1 sample / 4 hrs	8
Noise	Leq	5 day / quarter	0600-2200	8
Vibration	VL_{210}	5 day / quarter	0600-2200	5

Baseline Conditions

Baseline conditions for the programme will be established during the pre construction phase with relevant measurements taken to establish, as far as is possible, the ambient conditions. The programme of works should ensure that the baseline conditions defined represent actual conditions for 1998/99. A similar programme should also be undertaken for each relevant highway section over a period 3 months prior to section opening.

While this may appear to be an obvious requirement, it is often the case that projects are identified, developed and implemented at a pace that allows only the most rudimentary assessment of ambient conditions to be made. In these circumstances, it is not uncommon for serious sampling / data collection, and interpretative errors to be made that provide a false image of the ambient environment. To ensure that this does not occur in this case it is proposed that preparatory works are initiated as soon as possible.

12.5.3 Analysis

There are a number of good laboratories in the Amman Area that could adequately carry out the analysis required. The RSS and the University of Jordan both have the required capability and it is not unlikely that other alternatives would also be available.

12.5.4 Reporting

Reporting for each monitoring programme, noise and air quality, shall be produced on a six monthly basis. Each report should contain as a minimum the following sections.

- sampling, methodologies, equipment calibration reports, other background material
- the empirical findings
- statements of any extreme events or incidents reported that may abnormally influence the empirical findings
- analysis of the findings highlighting any changes of significance and possible, probable causes of change
- recommendations on actions to be taken
- follow up on any previous recommendations

All reports prepared should be submitted to the Project ELO who should, on completion of project construction works prepare an end of project monitoring review report. This shall contain:

- background to the project
- the empirical findings of the monitoring programme and the site inspections
- a statement on the methodologies adopted for monitoring, the suitability of equipment utilised, its performance, the practical and technical difficulties experienced in collecting and analysing the data. Recommendations for future works
- a statement on suitability of resources available for monitoring and inspection and recommendations for future works
- a statement on the efficiency or otherwise of mitigation measures proposed
- a statement on the significance of any changes identified, both physical and social, as compared to those predicted
- a statement of lessons to be learnt and recommendations on any actions to be taken to ensure that these lessons are translated into positive actions on future projects
- a summary statement of the overall impact on the environment of the construction phase.

All reports prepared during the construction phase should be circulated to GCEP and MPWH and made available at the Project Offices in Sahab and Zarqa. Annual

Environmental Reports should be produced throughout the construction period. It is envisaged that this report will have two principal sections:

(i) Review of Project Performance

This will outline the performance of all agencies involved in the Project; improvement or deterioration, as measured against previous baselines and established targets where appropriate; and establish new performance targets.

In the latter context, it is recommended that appropriate, specific targets, are employed in the assessment process to ensure that the findings permit direct comparison with previous performance and in the context of defined objectives. If a specific evaluation technique or framework is not adopted, annual targets for achievement will need to be defined for the upcoming year in the annual report. The ELO will be responsible for the preparation of the Annual Report.

The assessment should draw on the findings of the inspection reports, monitoring programmes and environmental audits.

(ii) Review of Project Works

This would comprise a review of all actions undertaken within the Project in the previous period. It would include as a minimum:

- Progress reports on project and programme implementation
- Summary report on training programmes / workshops held etc.
- Activity report on the awareness campaign
- Activity report of site inspections programme
- Activity report from the monitoring and audit programme

In general terms each report should contain:

- background to the project /programme / works
- summary statements of methodologies adopted
- summaries of findings
- a statement of lessons learnt
- recommendations for future works

12.5.5 Responsibility

Substantial resources will need to be deployed to adequately cover the monitoring and reporting requirements of the proposed programme. Three options are apparent:

(i) Establish within the PIU an environmental monitoring group
(ii) Contract to GCEP

Though at this stage, the GCEP is not viewed as being operationally fully developed, it could be developed, relatively quickly, in to a vehicle through which all official monitoring works are channeled.

(iii) Contract to the Private Sector

The ELO should supervise and manage contractors employed to carry out the required monitoring and testing programmes and provide the assessment reports.

Option (i) is not preferred. It is viewed as duplicating the role of the GCEP and potentially would provide only limited long term benefit especially if the unit is not maintained or developed to operate outside of the project framework. Either of cases (ii) and (iii) is considered appropriate.

Option (ii) is will provide a framework for capacity building at the HQ of the GCEP and facilitate the development of a strong relationship between MPWH and GCEP, and the development of cross sector channels of communication and information. A major drawback of this option is that it is rather too project specific and not entirely in keeping with GCEP's intended supervisory role,

On the other hand, Option (iii), by excluding GCEP would do little to build long term sector institutional capacity. It is proposed therefore that a fourth, option in which RSS is contracted to GCEP to provide the services required as happens at present with a number of other contracts is adopted. This should apply for at least two years.

This would strengthen GCEP in its key supervisory area of activity while maintaining the independence of the programme and its reporting. Under this structure the ELO will have no direct role in the supervision of the works but will contract them to GCEP. Nevertheless he should be kept closely involved and should be invited to attend regular debriefing sessions by GCEP. Thereafter, if it is considered appropriate it may be desirable to let the contract out to full tender for the remaining two, two year periods.

If this approach is adopted, GCEP would be under contract to PIU to carry out the following works

- Preparation of scopes of works and contract documentation for monitoring and auditing works
- provision of technical support to ELO in evaluation of bids
- supervision of contractor
- undertaking a limited number of check measurements (optional)
- review and evaluation of reports
- preparation of monthly progress reports

In this case, therefore the contractor will submit all documents to both GCEP and ELO. The contractor shall however be contracted directly to the PIU.

The finance for the contracts should be derived from a budget line to be disbursed by the PIU. This account shall be managed by the ELO according to the disbursement conditions in force at the PIU.

12.5.6 Cost Estimates

It is proposed above that these works be contracted out to the RSS for at least the initial two year period. They would therefore be subject to specific negotiation. However indicative costs are outlined below for budgeting purposes. Table 12.3 contains outline labour costs for sample collection and Table 12.4 analysis costs.

Table 12.3 Environmental Quality Monitoring: Labour Costs

Phase	Parameter	Person/site	Sites	Events /yr	JD/ person /day	Cost per annum
Year 1 Construction	TSP	1	4	4	15	240
	NO_X/ CO	1	3	28	15	1260
	Noise / Vib	4	5	12	15	3600
Sub Total						5100
Driver		1	160	1	6	960
Total						6060
Year 2-4 Constr.	TSP	1	4	4	15	240
	NO_X/ CO	1	3	28	15	1260
	Noise / Vib	4	5	12	15	3600
Ops. (baseline)	TSP/ Pb Dust	1	5	4	15	300
	NO_X/ CO	1	8	28	15	3360
	Noise / Vib	4	5	12	15	3600
Sub Total						7200
Drivers		1	304		6	1824
Total						9024
Year 5-6 Operations	TSP/ Pb Dust	1	5	4	15	300
	NO_X/ CO	1	8	28	15	3360
	Noise / Vib	4	5	12	15	3600
Sub Total						7200
Driver		1	304		6	1824
Total						9024

Summary of Proposed Sampling Programme Frequency: Construction

Parameter	No. of Sites	Samples per event	Days per event	Events per Qtr	Events per yr	Unit Rate JD	Total Cost
TSP	4	1	1	1	4	46.5	744
NOX	3	7	7	1	4	4	2352
CO	3	7	7	1	4	3.5	2058
Noise	5	3	3	1	4	1.2	216
Vibration	5	3	3	1	4	2.5	450
							5820

Summary of Proposed Sampling Programme Frequency: Operations

Parameter	No. of Sites	Samples per event	Days per event	Events per Qtr	Events per yr	Unit Rate	Total Cost
TSP	5	1	1	1	4	46.5	930
Pb Dust	5	1	1	1	4	85	1700
NOX	8	7	7	1	4	4	6272
CO	8	7	7	1	4	3.5	5488
Noise	5	3	3	1	4	1.2	216
Vibration	5	3	3	1	4	2.5	450
							15056

Table 12.4 Summary of Monitoring Costs

Phase	Const.	Operations	Total	Grand Total
Year 2-3				
Samples	5820	-	5820	
Labour	6060	-	6060	
Total	11880	-	11880	23760
Year 4				
Samples	5820	15056	20876	
Labour	6060	9084	15144	
Total	11880	24140	36020	36020
Year 5-6				
Samples	-	15056	15056	
Labour	-	9084	9084	
Total	-	24140	24140	24140
Grand Total				72050

Maximum total monitoring costs including audits and inspections are as follows:

Year	Programme	Cost (JD)
1	Inspections	36,250
	Audit	6,000
	Environmental Quality Monitoring (Fixed)	-
	Environmental Quality Monitoring (Complaint Based)	-
Total		**42,250**
2	Inspections	31,450
	Audit	6,000
	Environmental Quality Monitoring (Fixed)	23,760
	Environmental Quality Monitoring (Complaint Based)	2,500
Total		**63,710**
3	Inspections	31,450
	Audit	6,000
	Environmental Quality Monitoring (Fixed)	36,020
	Environmental Quality Monitoring (Complaint Based)	3,600
Total		**77,070**
4	Inspections	11,250
	Audit	2,500
	Environmental Quality Monitoring (Fixed)	24,140
	Environmental Quality Monitoring (Complaint Based)	2,400
Total		**40,290**
Grand Total		**223,320**

12.6 CRIA AND LARP PROGRAMMES

12.6.1 CRIA

The proposed monitoring programme for the CRIA will be undertaken by the CRM unit of DAJ. The estimated costs for the programme are JD 13,000. The labour budget for monitoring works is JD 10,000 summarised as follows:

Item	Quantity	Unit Rate (JD)	Cost (JD)
Archaeology Supervisor	120 days over spread over four years	25	3000
Archaeology Assistant	450 days spread over four years	15	6750
Total			9750 10000

The assistants input is defined as per the Inspections and reporting breakdown shown below.

Task	Units	No per Year	No years	Total
Quarterly Inspections	8 per quarter	32	2.25	72
Pre programmed Visits	2 days per defined archaeology site per annum	46	-	76
	2 days per 15 other events	30	-	
Inspection Reports	1 day per visit	-	-	148
Six Monthly Reporting	21 per unit	42	2.5	105
Sub Total				401
% contingency				49
Total				**450**

The supervisors input is assessed as one month per annum for four years equivalent.

The principal reporting mechanism of the CRIA monitoring programme will be an end of Project workshop for which a further JD 2000 is allocated. Interim reports on activities carried out will be prepared on a six monthly basis. These will be submitted to the DAJ, GCEP and ELO. A further JD 1000 is allocated for these works.

12.6.2 LARP

Three forms of monitoring are required;

- Internal Monitoring of the Performance of the LARP with respect to the effectiveness of the processes established and ultimately therein, the disbursal of compensation,
- Independent Monitoring of the Processes and the Compensation
- External Monitoring .

(i) Internal Monitoring

Internal monitoring will be a primary responsibility of the CLM. The programme will have a number of specific objectives:

- To provide early warning of LARP related project difficulties and concerns
- To monitor the progress of LARP implementation against predetermined performance targets.
- To ensure that payments are made to the correct individual and as in the compensation agreement and that other entitlements are also made available as promised.
- To facilitate the work of the external and independent monitors through effective record keeping and the preparation of Project Progress Reports for each two month period the LARP is operational.

These latter reports to be submitted to the Secretary General of the MPWH the Ministry of Planning and the PCC will provide the basis for assessing project performance. The costs of this are accommodated in the LARP implementation budget.

Independent Monitoring

It is proposed to appoint a single inspector drawn from international development assistance (a representative from a development agency working in the field, (e.g. UNDP), or NGO. The primary objectives of the inspector are as follows:

- to review compensation negotiation processes to ensure that **all** PAPs are receiving adequate support and advice from their CLOs. That some are not being disadvantaged by poor CLO performance.
- to monitor the reaction of the PAP community to the processes and procedures adopted in the implementation of the LARP programme and to document opportunities for future improvement.
- to ensure that adequate compensation is paid on a timely basis.
- to respond to complaints received over late or delayed payments or negotiation concerns etc.
- to review the deliberations of the CRB (including observation of proceedings if felt necessary).

Payment for the Monitoring Inspector will be via a fund established by the MPWH for that purpose and will be on a fixed contract basis. The costs of the monitor are as follows:

200 days @ JD 100 per day[2]: JD 20,000

External Monitoring

The progress of the implementation and monitoring of the LARP and associated mitigation measures will be reviewed from time to time by external, WB and EIB, constituted missions. Two specific missions will be required to:

- undertake a mid term review, End Third Quarter 1999
- prepare an end of LARP review report in co-ordination with the senior NGO inspector and the CLM.

12.7 CAPACITY DEVELOPMENT AND TRAINING

This outline monitoring plan contains a number of elements intended to increase the implementation capacity of target organisations. Specifically,

- Establishment of an internal PIU with CLM and CLO units
- Contracting of monitoring works to Jordanian agencies and allocation of a supervisory role to GCEP.
- Adoption of an inclusive approach to project monitoring works in which project findings are to be the subject of workshops and peer review.

To supplement this basic approach, two training programmes are proposed:

[2] Includes the costs of preparation of the end of PAP implementation review

(i) Post specific training for the CLM, CLOs and others associated with the implementation of the LARP. This will the CLM Internal training for

- general training in dealing with the public on an interpersonal basis,
- basic counseling techniques
- workshops intended to sensitise all parties involved in the implementation of the LARP with the process.

A lump sum budget of approximately JD 10,000 is allocated to cover the costs of this programme.

(ii) External training

This will involve overseas training or preferably training in Jordan through an extension of one of the ongoing GCEP support programmes.

Proposed topics for training are:

- Public Consultation in the Project Design Process
- Land Use Planning and the Urban Transport Policy
- Monitoring of Urban Transport Pollution
- Urban Noise Control Techniques
- Social Impact Assessment
- Risk Assessment
- Application of Monetary Values to Environmental and Social Issues in Cost Benefit Analysis.

The target group for this programme is seven staff, two from each of MPWH and GCEP and one each from the Municipalities of Amman, Sahab and Zarqa

A total training period of 4 weeks is anticipated. Broad costs for this programme are JD 25,000.

Total training costs are therefore set at JD 35,000.

SECTION 13:

CONSULTATION PROGRAMME

SECTION 13 CONSULTATION PROGRAMME

13.1 INTRODUCTION

The Project Information Participation and Consultation Programme has been undertaken in two stages. The first stage of three Scoping Sessions and a Review meeting was carried out during the Prefeasibility stage of the study and was reported on extensively in Volumes 3 and 4 of the Prefeasibility Report. This element of the programme is therefore only briefly touched upon in this text.

The second Phase of works associated with the Feasibility Study comprised:

- Two technical seminars dealing with issues of primary concern; Cultural Resources and Social Issues
- A Repeat Session at Zarqa to discuss the new project components, the Zarqa Through Route, Zarqa Eastern by Pass and the Previous Session
- Two Project exhibits to which members of the Public were invited (via the Media)
- An EA review meeting held at the offices of the GCEP.

Full lists of the participants are provided as Appendix O to this Report.

13.2 REVIEW OF PHASE 1 SESSIONS

13.2.1 Findings

Three categories of impact, or area of concern, were identified for the Scoping Session working groups.

- Natural and Physical Environment;
- Land Acquisition and Resettlement; and
- Cultural Heritage and Urban Issues.

The impacts defined by each group were then classified, grouped, allocated a significance and finally tabulated in an impact identification matrix. The results of the three Sessions are summarized into the nine matrices reported on by the Moderators, (Appendix P).

In total, the nine working groups identified some three hundred issues though many of these were duplicated, directly or at least in part. Combined matrices for each category, have therefore been produced. The matrices produced are considered to reflect the views and opinions of participants in the three scoping sessions but to ensure that the views of the participants were correctly understood and interpreted some issues reported at the scoping sessions were presented at the Review Meeting, for clarification. The issues derived from these sessions that have a direct bearing on the Eastern Sections of the road are summarised below.

(i) Natural and Physical Environment

- **Land Use:** Improved access will also encourage changes in land use patterns and further loss of agricultural and rangeland, For Sections 1 and 2 of the ARR, the participants in the Zarqa Scoping Session identified potentially positive impacts from the encouragement of industrial developments within arid areas reducing pressure on the environmentally sensitive areas. Finally, there were concerns that pollution of agricultural produce (in the field) by construction and vehicle movement will reduce its quality and potentially generate a health threat.
- **Water resources:** Two issues relating to water were of concern One relating to water demand; during construction and, after construction, the water needs of induced developments and the other, to potential changes in flow patterns, affecting local aquifers and causing flooding and soil erosion.
- **Pollution:** The negative impacts of increased air pollution during construction, and later, vehicle exhaust emissions introduced to rural areas were noted. However, the benefits of a reduction of urban air pollution by removing heavy traffic from residential areas were also identified.

(ii) Cultural Heritage and Urban Issues

Under the cultural heritage and urban issues category the following impacts were identified:

- Historic and tourist: The ongoing study should identify possible sites and their classification and provide an initial overview of the preventive and mitigate measures required. Section 3 of the road, could change the regional and local touristic values by the scarring of attractive landscapes. Local community members and NGOs are strongly aware of this and stressed the need to avoid such areas or design the road in harmony with the environment and use natural screening measures using native trees.
- Urban / Social issues: Issues raised differ from one area to another. In Sections 1 and 2 of the road, local community leaders reflected positive views in relation to increased opportunities in terms of social interaction, jobs, better access and improved transport.

(iii) Land Acquisition and Resettlement

Land acquisition and resettlement issues were generally a cause of much concern and a number of factors, present land compensation law; historical mistrust between land owners and local authorities; tribal value and sense of identity attached to land; all acted to make these discussions the source of most of the controversy at the sessions. Specific issues addressed included:

- Planning issues relating the uncontrolled expansion of Amman and associated increase cost of services and unplanned development.
- Environmental issues noted previously will arise here, caused by change in land value and land use, which will promote the loss of more agricultural land and natural areas, reflecting negatively on wildlife and landscape.
- Economic: The ARR will change land values, hence affecting different groups of land owners in unequal manner. It will improve the value of some lands and reduce the value of others,

creating new opportunities and causing loss of businesses. Current land compensation law does not have the flexibility to deal with complex situations caused due to different values and can not deal with individual cases in their own merits. Small land owners feel threatened over the loss of their land or change of land used induced by the road.

The Plenary Sessions generated additional comments and concerns that were often strongly expressed. These can be are summarised as follows:

- The existing land acquisition compensation law is not fair; Particular concern was expressed over the 25% 'free land' in acquisition and the payment of compensation at 'existing' values and not the enhanced values after construction.
- The public consultation should be carried out at all stages of the project, and the public concerns should be taking in consideration during the design, implementation and operation stages;
- The effect of this project in terms of its political and financial implications as reflected in the additional borrowing on behalf of the government, and its effect on the balance of payment should be thoroughly assessed.
- Resettlement issues should be studied carefully to reduce social impacts;
- Strong positive views were voiced on promoting needed investment and serving existing industries mainly in Sections 1 and 2 of the proposed ARR; and
- Issues relating to accidents and disruption of economic and social patterns of life during construction are raised, measures should be taken to reduce to a minimum.

13.2.2 Positive Impacts

One of the more significant findings of the sessions was the general recognition of the participants of the potential benefits of the project, i.e. its positive impacts. This is shown most clearly in Table 13.1 which contains a summary of the ranking of the most significant impacts (as defined by their ranking as of the highest significance at at least two sessions) and in which 6 of the 13 are positive.

13.2.3 Findings and Recommendation of the Review Meeting

The full matrices developed as of result of these discussions are presented in Appendix Q. A summary of the principle findings is provided as Table 13.2

With one caveat, the relatively high number of responses calling for other capital investment, this distribution of responses is broadly along the lines that might be expected. For project planning purposes the Consultants have identified three points of note from the review of options that may have the most bearing on the development of the Environmental Management Plans for Sections of the ARR.

(i) Issues relating to involuntary resettlement do not appear to be viewed by participants in the sessions as a major project related issue. In this context four key points emerge:

Table 13.1 Classed as Highest Significance in all Sessions

	Significance					
Impact	5	4	3	2	1	**Remarks**
Reduce traffic jams	ZAF					
Inadequate land compensation	ZFA				Z*	*Tribal lands
Loss of forest	A(w) ZF		A(e)			
Impact on natural ground cover	FZ*	Z	A			*Beirain, Shafar and Badra areas specified
Air +	ZF	A				May reduce city pollution during operation
Improve Regional / local Transport	FZ	A				
Loss of agricultural land	ZF		A			Western part
Change in land use	AF		Z			
Damage / destruction / displacement of archaeological sites	AF			Z		Conduct survey
Stimulate econ gwth esp. in Tourism	FZ					
Improve National Transport	ZF					
Serve existing economic sectors	FA*	A				*Sector specific
Increase land value	AZ					

Positive Impact

Table 13.2 Summary of Mitigation Options Findings

Priority Issue	Addit. Legis. Regul.	Project Related Monit.	Project Design / Invest.	Other Cap. Invest.	Econ. Tools	Enforce. / Institut. Reform	Info. / Res. Consult.	Pub. Awness.
Maximum	**46**	**46**	**46**	**46**	**46**	**46**	**46**	**46**
Total	**5**	**21**	**25**	**18**	**14**	**20**	**16**	**20**
Land Acquisition and Related Issues	1	2	3	3	3	2	3	4
Destruction and Damage to Natural Resources		7	7	3	3	4	5	4
Land Use / Urban Development	2	2	5	2		8		5
Infrastructure and Access	1	6	6	4	2	3	3	
Social Concerns		1	1	3	4	2	1	3
Agriculture		1	1	2	1		2	2
Cultural Sites	1	2	2	1	1	1	2	1

- Resettlement was not viewed as a direct project related cost.
- Equally, it appears that the existing regulations available for resettlement are viewed as adequate.

- The lack of a perceived need to monitor resettlement issues in a context when monitoring was identified very strongly as a preferred mitigation option.
- Information, Research and Consultation was ignored as a mitigation option

Overall this would seem to suggest that a somewhat sanguine view of resettlement was taken by participants. Whether this perception is a function of an understanding that little or no resettlement will be necessary for the project (and therefore is not a pressing issue) or is a correct interpretation of the wider view on resettlement can of course not be determined at this stage.

(ii) Project monitoring as a concept seems to have gained a relatively strong position in the perception of participants especially with respect to the natural environment.

(iii) The participants were generally of the view that there was probably sufficient legislation available in most instances to manage project impacts provided it was effectively applied. This is nowhere better illustrated in the area Land use and Urban Development where for 8 of 13 issues Enforcement / Institutional Reform / Strengthening was identified as a Mitigation Option, and where it represents 33% (8 of 24) of all options identified

13.3 PHASE 2 PROGRAMME

13.3.1 Thematic Seminars

(i) Cultural Resources

The main objectives of this seminar were to:

- Provide the archaeology community with information on the Project and its present status;
- Present the findings of the survey works carried out to date;
- Discuss and comment on the initial mitigation plan proposed by the Archaeology Study Team and propose any other measures that the participants feel are necessary.

To achieve these objectives target groups were identified through consultations with the main national archaeological NGO; the Friends of Archaeology as well as the British Institute at Amman for Archaeology and History in Jordan. These organizations provided lists of agencies and individuals who should attend the seminar and who may contribute to the initially proposed mitigation plan. The suggested agencies and individuals were contacted and invited. These consisted of the following:

- Antiquities Department of Jordan.
- NGOs and Foreign Institutes
- Cultural Centers
- Donor Agencies
- General Corporation for the Protection of the Environment
- Universities

They were provided with a brief document on the background of the Project and the Archaeological Study. One of the Amman City Hall meeting rooms was chosen as venue for the seminar. Twenty three participants attended the seminar, broken down as follows:

- 10 representatives of national NGOs
- 2 representatives of international institutes operating in Jordan,
- 9 representatives of the Department of Antiquities of Jordan,
- 1 representative of the Private Sector
- 1 representative from Yarmouk University,

Representatives of national NGOs were active in the discussions and requested to be provided with a brief document giving more details on the specific sites which were surveyed in the Study since that will help them participate in thinking out the mitigation measures.

Dr. Mohammed Waheeb CRM Archaeologist gave a presentation of the methodology of the Archaeology Survey and Summary of its findings. He explained the concept of CRM and explained, using a slide show, the steps taken to identify archaeological sites along the ARR corridor (Section 1). Dr. Waheeb explained the sites were classified according to significance as high, medium and low, and discussed degree of risk that these sites will be subject to, tying significance to risk. However, participants expressed their confusion regarding this point. There seemed to be a general consensus that sites should be classified both in terms of significance as archaeological and heritage sites, as well as in terms of possible risk as a result of the Project activities.

Participants identified the following issues as important factors to be taken into consideration in classification of sites and in thinking out the possible mitigation measures:

- The study should take into consideration the fact that cultural sites are not only archaeological, but also sites of importance in terms of social and historical heritage of the communities.
- Classification of significance of sites should not only consider the site as an individual entity, but rather should look at it as part of a more comprehensive totality that several sites may constitute.
- Attention should be given to the total visual aspect of sites, and the overall landscape that these sites contribute to should not be disturbed.
- In the mitigation measures, participants expressed their hope that the possibility of covering sites that will be affected by the Project, after documenting them, will be studied instead of relocating or totally destroying them.
- Participants expressed the need for further assessment of the sites, since further excavations may reveal a different view as to the significance of the concerned sites.

In addition participants requested that a brief document be provided to them showing the different sites that the Study has identified, so that they can have a better idea and would be able to contribute to the discussion of classification of sites as well as mitigation measures.

(ii) Socio-economic Study Seminar Sahab

The main objectives of the seminar were defined as follows:

- Provide the local community with information on the socio-economic study conducted under the Project, its methodology and findings.
- Discuss and comment on initial proposed mitigation measures in the field of socio-economic impacts of the Project.
- Present an overview of the Project and the Public Participation and Consultations conducted up till now.

The target group for the seminar was identified through consultations with the Jordan Environment Society/ Sahab Branch, the Sahab Municipality and the Womens Forum in Sahab. The suggested agencies and individuals were contacted and invited and provided with a brief document on the background of the Project.

Excluding Project team members and MPWH officials, 42 participants attended the Seminar, including 13 local community representatives, 10 municipalities, 6 NGOs and clubs, and a range of other individual representing local groups.

The principal conclusions of the participants discussions were as follows:

- Participants recommended expediting implementation of Project, since they all believe it is essential to their area.
- Recommend formation of a committee in which the local community is represented to look into compensation of affected individuals and groups.
- Provide local community with consultations during the transit period of resettlement.
- The necessity of giving local community job opportunities in the Project.
- Service utilities should be rehabilitated if damaged by the Project.
- Safe access should be provided to communities.
- Trees should be planted along the road.
- Create a link between the local communities, MPWH and the Social Security Package Programme at the Ministry of Planning, to serve objectives of the Project and the development aspect (training... etc.) that will be provided by the SPP programme.
- Legislate land use plans before implementation of Project in order to control ad hoc development and land speculation.
- Integrate the Project with the comprehensive development vision.
- Create a mechanism for follow up and evaluation for the Project concerning compensation, acquisition and development in the area.
- Study the compensation law.

13.3.2 Zarqa Scoping Session

The main objectives of the session were to:

- Present an overview of the Public Participation and Consultations Programme conducted under the pre-feasibility and feasibility study of the ARR.
- Follow up on the first scoping session which was held in Zarqa in October 1997, present the preferred alignment options of the Road at this stage, asking participants to list the possible impacts in light of the new information provided in the session.

To achieve the session objectives, the target group for the session was identified through consultations with the Jordan Environment Society/ Zarqa branch, the Chamber of Commerce in Zarqa, the Municipality of Zarqa, and the Womens Forum in Zarqa. These organisations provided lists of agencies and individuals who should attend the session.

The invitees were provided with a brief document on the background of the Project. The main hall of the Chamber of Commerce of Zarqa was chosen as venue for the session. Boards featuring an overview of the Project and the phases of the EIA study conducted for it, with maps and photographs were displayed in the entrance hall to enable participants to have a broad view of the Project.

Excluding MPWH staff, consultants and WB mission staff 31 people attended the session as follows:

- 4 NGOs,
- 8 from Zarqa and other Municipalities,
- 4 industries, and the Chamber of Commerce
- 6 ministries,
- 2 military Housing Corp.
- 2 Al Hashemiyah University,
- 1 freelance consultant,
- 1 professional association,
- 1 local community representative,
- Chief of Traffic/Zarqa.

Participants comments included the following:

- The Zarqa through route was seen as important for Zarqa in that it will decrease the traffic congestion inside the city and allow for better distribution of traffic.
- Many participants believed that the by-pass route around Zarqa should take the further east alternative, because it would serve the expected development in the area.
- Participants recommended that the Zarqa Development Plan be taken into consideration in deciding the final route.
- Participants recommended that the Project learn from previous experiences and mistakes made in previous projects in regard to access, lighting, service areas, safety, etc.

- Participants had questions on the acquisition law (25% compensation), as well as the road tolls.

13.3.3 Sahab and Zarqa Exhibits

In order to provide information on the ARR Project to as many stakeholders as possible exhibits were organised for Zarqa and Sahab. In Sahab arrangements were made to meet with representatives from the Jordan Environment Society/ Sahab branch, the Sahab Municipality and the Womens Forum in Sahab, who advised that the exhibit and the seminar be held at Hafsa Bint Omar Girls School. These officials made the necessary arrangements with the school's administration.

The exhibit was announced in the local newspapers and boards were prepared in Arabic and English to inform people of the project, its status, preferred alignment and options considered to date. The exhibit was open from 10:00 AM till 6:00 PM.

At Zarqa arrangements were made with the Mayor of Zarqa to hold the exhibit at the Library Hall in the Municipality Commercial Building. This event was also announced in the local newspapers.

A total of some 114 people attended the two exhibits including: municipality members, local dignitaries, local community, private sector and NGOs.

Although virtually all visitors applauded the idea of the exhibition some expressed the wish that a brochure on the project had been made available.

13.4 EA REVIEW MEETING

A review meeting for the EA was held at the offices of GCEP on June 6th 1998. This meeting was jointly organised by the MPWH and GCEP to bring together key representatives of project stakeholders, Government departments, NGOs, Municipality Officials and potential project financiers to review Study findings and recommendations and contribute to the development of the final Project Mitigation Options framework.

A list of 25 invitees was agreed with the MPWH and GCEP. Of the these invited some 25 individuals from 13 agencies attended.

The Consultants provided a brief overview of the project including a short summary of the Technical and economic Feasibility Reports and a review of the Environmental Impact Assessment findings.

The discussions that followed the presentation concentrated on a limited number of specific issues as follows:

- The emergency procedures associated with the road and accessibility to emergency facilities,
- The extent of the landscaping proposals,

- Maintenance of access to properties,
- The need for planning in the immediate vicinity of the road alignment,
- The impact on drainage patterns and proposals to minimise the erosion threat.

Perhaps the most significant issue raised was the lack of an ecological surveys of the corridor / alignment with participants taking the view that such a survey was necessary if the EA was to be considered complete. In consideration of this a survey has been commissioned and the results of that survey should be available by September 1998. The TOR for this study are attached as Appendix R.

Beyond this specific issue most interest centred on the status of the Project and the extent to which the findings of the EA would be incorporated into the Project Design.