Red Sea-Dead Sea Water Conveyance Study Environmental and Social Assessment

Preliminary Draft Environmental and Social Assessment (ESA) – Executive Summary

July 2012

Red Sea-Dead Sea Water Conveyance Study Environmental and Social Assessment

Preliminary Draft Environmental and Social Assessment (ESA) – Executive Summary

July 2012

Reference: 0084840

Prepared by: ESA Study Consortium led by Environmental Resources Management (ERM) Limited

For and on behalf of
ERM Ltd & ESA Study Consortium:

Approved by: Dr Eamonn Barrett

Signed: 

Position: Partner

Date: 26th July 2012

LIST OF ABBREVIATIONS

ABO	Aqaba Bird Observatory
ACT	Aqaba Container Terminal
ADC	Aqaba Development Corporation
APA	Aqaba Ports Authority
APC	Arab Potash Company
ASEZ	Aqaba Special Economic Zone
ASEZA	Aqaba Special Economic Zone Authority
BSSA	Bethlehem Water Supply and Sanitation Authority
CBOs	Community Based Organizations
CDM	Clean Development Mechanism
CR	Critically Endangered
DSMS	Dead Sea Modelling Study
DSP	Desalination plant
DSW	Dead Sea Works
DZC	Development Zones Commission
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EN	Endangered
EPP	Enhanced Productivity Program
ESA	Environmental and Social Assessment
ESMP	Environmental and Social Management Plan
EQA	Environment Quality Authority (PA)
EWASH	Emergency and Water Sanitation Hygiene Group
FOEME	Friends of the Earth Middle East
FS	Feasibility Study
GHG	Greenhouse Gas
GID	General Intelligence Department
GoA	Gulf of Aqaba
GOJ	Government of Jordan
GOI	Government of Israel
GSI	Geological Survey of Israel
GUVS	General Unions of Voluntary Services
HEP	Hydro Electric Power Plant
HGV	Heavy goods vehicle
HPP	Hydropower plant
IBA	Important Bird Area
IBRCE	International Birding & Research Center in Eilat
IEMA	Institute of Environmental Management and Assessment
IFC	International Finance Corporation
IOLR	Institute of Oceanographic & Limnological Research
IUED	Israeli Union for Environmental Defence
IUI	Inter University Institute (for Marine Science at Eilat)
JEEC	Joint Environmental Experts Committee

JICA	Japanese International Cooperation Agency
JMA	Jordan Maritime Authority
JOHUD	Jordan Hashemite Fund for Human Development
JPMC	Jordan Phosphate Mining Company
JREDS	Jordan Royal Marine Conservation Society
JRF	Jordan River Foundation
JRSWP	Jordan Red Sea Water Project
JUST	Jordan University of Science and Technology
JVA	Jordan Valley Authority
LC	Least Concern
MEP	Ministry of Environmental Protection (Israel)
MoE	Ministry of Environment (Jordan)
MoMA	Ministry of Municipal Affairs (Jordan)
MoPAD (formerly MoPIC)	Ministry of Planning and Administrative Development (Jordan)
MoSD	Ministry of Social Development (Jordan)
MPWH	Ministry of Public Works and Housing (PA)
MSBs	Migratory Soaring Birds
NAF	National Aid Fund
NGO	Non-governmental organization
NHF	Noor Al Hussein Foundation
NIPs	National Implementation Plans
NPA	National Parks Authority
NRA	Nature Reserves Authority
NT	Near-threatened
PA	Palestinian Authority
PCBS	Palestinian Central Bureau of Statistics
PCCP	Public Consultation and Communications Plan
PEAP	Palestinian Environmental Assessment Policy
PERSGA	Regional Organization for Conservation of Environment of the Red Sea and Gulf of Aden
PESAR	Preliminary Environmental and Social Assessment Report
PHG	Palestinian Hydrology Group
PM	Passage Migrant
POPs	Protocol on Persistent Organic Pollutants
PWA	Palestinian Water Authority
R	Resident, breeds
RB	Resident breeders
RSCN	Royal Society for the Conservation of Nature
RSDSC	Red Sea Dead Sea (Water) Conveyance
RSMS	Red Sea Modelling Study
SARS	Severe Acute Respiratory Syndrome
SB	Summer Breeders
SCAs	Special Conservation Areas
SIZ	Southern Industrial Zone
SoA	Study of Alternatives
SPNI	Society for the Protection of Nature in Israel
SRO	Seawater Reverse Osmosis

STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infection
SV	Summer visitor, breeds
SWM	Solid Waste Management
TBM	Tunnel Boring Machines
ToR	Terms of Reference
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	The United Nations Children's Fund
UNRWA	United Nations Relief and Works Agency
VU	Vulnerable
WAI	Water Authority of Israel
WB	West Bank
WMP	Waste Management Plan
WV	Winter Visitor

EXECUTIVE SUMMARY

PREAMBLE

The following document is a summary of the *Preliminary Environmental and Social Assessment Report (PESAR)* prepared as part of the Environmental and Social Assessment (ESA) Study of the proposed Red Sea Dead Sea Water Conveyance (hereafter referred to as 'the RSDSC' or 'the Scheme'). It presents an assessment of impacts based on the Scheme design and associated technical studies set out in the Draft Sub-Studies Report released in December 2010 as part of the RSDSC Feasibility Study (FS), and also takes into account some amendments to the Scheme design set out in the FS Draft Final Report Summary of July 2012.

OVERALL SUMMARY AND CONCLUSIONS

Key Impacts

The recommended Scheme configuration emerging from the Feasibility Study is a piped or tunnel sea water conveyance from the Red Sea coupled with desalination on the edge of the Dead Sea basin and freshwater pipelines to population centres in the Beneficiary Parties. This represents a fairly conventional linear construction, avoiding the usual drawbacks of this type of project that include displacement, resettlement, disruption of social and commericial activities, and severance of communities and ecosystems. This is in part because the preliminary design in the FS has been drawn up with great attention to possible environmental and social concerns, but also because the conveyance and pipeline routes traverse sparsely populated desert areas.

The potentially most significant environmental and social issues identified during the scoping phase of the ESA study (1) are summarised in *Table ES.1*. These are described later in this Executive Summary and discussed in detail in the main PESAR. In summary, the key issues centred around the effects on the water bodies at either end of the conveyance, the rare and/or fragile aspects of the desert ecosystems, the archaeological heritage and disturbances to those communities that live in and around the Wadi Araba/Arava Valley.

An issue of potentially major concern to the environmental and social acceptability of the RSDSC is the risk that the influx of seawater and reject brine into the Dead Sea will cause changes to the appearance and water quality such that its value as a heritage site of international importance will be damaged. Precautionary measures to attenuate this risk have been included in the Environmental and Social Management Plan (ESMP) developed for the Scheme. In addition, a Dead Sea Modelling Study (DSMS) was carried out as part of the RSDSC Study Programme to analyse these potential effects in more detail. However, following completion of the DSMS some uncertainty still

(1) ESA Preliminary Scoping Report, December 2008

remains regarding the potential scale and likelihood of these effects over the full range of inflow conditions (1). The ESMP therefore recommends that these modelling studies be continued in support of future decision making about the Scheme, and that they are supplemented by the results of physical trials, including the 'prototype' project described in the FS Draft Final Report Summary.

Table ES.1 Summary of Potentially Most Significant Issues (with and without ESMP)

Theme	Key Issues	Significance	
		Implemented as outlined in the FS	Implemented with ESMP
Dead Sea	Dead Sea appearance and water quality, and integrity as a heritage site	●	●
Red Sea	Effects on water quality, turbidity and coral/coral dynamics during construction and operation	●	O
Hydrology & flood risk	Risk of breaches in facility during major floods and consequent impacts on surface waters	●	O
Archaeology & cultural property	Potential disturbance of some 48 important archaeological sites	●	●
Social & socioeconomics	Land take, land use changes, interaction of residents with migrant workforce	●	●
Landscape & visual	Appearance of large desalination plant in Wadi Araba/Arava Valley & hydropower plant in Dead Sea Basin	●	●
Ecology	Construction disturbances to migratory birds, protected areas, endangered species, sensitive habitats	●	●
Hydrogeology	Catastrophic failure of pipeline leading to salination of groundwater in Wadi Araba/Arava Valley	●	●
Public Health	Risk of traffic accidents during construction	●	O
Nuisances & disturbances	Noise disturbance in some areas during construction	●	●
Energy demand & climate change	Significant use of non-renewable resources envisaged	●	●

Key:

● = positive; O = slight/none; ● = moderate; ● = major

Other potentially significant issues that could arise during the construction and operation of the RSDSC are discussed in later sections of the report, and as described can all be mitigated to acceptable levels by the effective implementation of the ESMP.

Acceptability of Scheme Variants

The draft FS report examined a number of options for each component of the Scheme and identified a recommended set of configurations based on cost and other feasibility criteria, henceforth referred to as the 'Recommended Scheme'.

(1) See DSMS Final Report, August 2011.

As shown in *Figure ES.1*, the Recommended Scheme comprises: the eastern intake; a pipeline seawater conveyance; a high level desalination plant site; an outfall canal following the route of the "peace canal"; and a freshwater pipeline route south of Tafila. The ESA studied the various component alternatives independently and compared them against the Recommended Scheme on environmental and social criteria. The results are summarised in *Table ES.2*.

Table ES.2 Comparison of Variants to the Recommended Scheme

Scheme component	Variant to Recommended Scheme	Comparitive enviromental and/or social performance		Explanation
		Without mitigation	With mitigation	
Intake Location	Northern Intake	🔴	🟠	Northern intake is inferior due to risks (flood, seismicity) that can be mitigated, albeit at considerable cost
Seawater Conveyance Type and Alignment	Low Level Tunnel	🔴 / 🟢	O	Low level tunnel is worse with respect to ecology and social impacts, better with respect to risk of leakage and visual intrusion. In either case, effective mitigation is available.
	High Level Tunnel, with canal sections	🔴	🔴	High level tunnel canal sections have significant social, visual and ecological effects for which effective mitigation is not available
Desalination Plant Site	Low Level Site at Ghor Fifa	🟠	🟠	Low level site potentially impacts newly established Fifa Protected Area
	High Level Site (for Tunnel)	O	O	Sites are equivalent, without significant impacts
Restitution Canal Alignment	Alignments 1 and 2 to east of ponds	🔴	🟠	Alternative alignments impact social, cultural and ecological resources, although the effects can be mitigated
Freshwater Pipeline Route (Jordan)	Alignment 2, Mu'tah	O	O	Alignments are equivalent, without significant residual impacts
	Alignment 3, Tafila	O	O	Alignments are equivalent, without significant residual impacts

Key:

🟢 = Significantly preferable; 🔴 = Significantly inferior; 🟠 = Moderately inferior;

O = No significant difference

Of the options analysed in the FS there are none that are clearly better from an environmental and social perspective than those comprising the Recommended Scheme. The high level (220m) tunnel is significantly inferior to either of the other seawater conveyance options, with no practicable mitigation measures. The alternative intake site, low level desalination plant

site and the Restitution Canal alignments to the east of the evaporation ponds also have significant drawbacks, although these could be mitigated to some extent.

Major Risks and Their Management

The RSDSC, when constructed as outlined in the FS, would entail fairly routine engineering construction of buried pipelines, some tunnelling, and a few permanent above ground facilities, including a large desalination plant (at maximum capacity, larger than any currently in operation). The usual drawbacks of this type of project (resettlement, disruption of commercial and domestic life, severance) have largely been avoided due both to the nature of the receiving environment and the environmental safeguards built into the route selection and initial design. The main environmental and social risks identified by the ESA are:

- unanticipated or unexpectedly acute impacts on Dead Sea quality;
- contamination of aquifers due to catastrophic failure of the saltwater conveyance;
- large-scale regional public opposition with mobilisation of international stakeholders;
- impacts arising from poor construction practice coupled with inadequate supervision (waste disposal, Health and Safety, nuisances);
- destruction or loss of archaeological and culturally significant sites;
- community objections at worksites because of land disputes, migrant labour, social changes or accidents; and
- disturbance to ecologically sensitive areas in the Wadi Araba/Arava Valley.

Mitigation measures to manage these and other potential impacts have been included in an Environmental and Social Management Plan (ESMP) that accompanies the ESA. This is designed to be incorporated in a series of documents that form binding contractual obligations on construction companies and plant operators and specify the supervision arrangments of the responsible regulatory bodies.

Summary Assessment

As stated above, the RSDSC has three objectives: to provide a critical potable water resource for the region; to save the Dead Sea from environmental degradation; and to provide a symbol of peace and cooperation in the Middle East. With appropriate attention to the implementation, supervision and monitoring of the ESMP, it is our judgement that the Scheme could be implemented without unacceptable environmental or social impacts, and in so doing achieve the first of these aims. However, some uncertainty remains with regard to the potential effects of the Scheme on the Dead Sea and therefore its ability to meet the aim of stabilising levels in the Dead Sea without causing damage to other aspects that contribute to its cultural value. This uncertainty relates to the likely scale and duration of effects on the

biophysical characteristics of the Dead Sea under different inflow conditions. Reducing this uncertainty will require further monitoring and research, leading to the development of effective mitigation strategies and measures if required; these could include the option of limiting inflows to the Dead Sea in future. In addition, notwithstanding that any damaging or irreversible effects on the ecology of the Dead Sea could be avoided or mitigated in this way, there would still remain a risk that any acute visible changes to the Dead Sea system might give rise to concern at both a regional and an international level. If it occurred, this concern could hinder development of the Scheme at some future date.

In summary, the above impacts could be reduced but not necessarily eliminated by a combination of the following:

- A phased approach combined with a proactive public engagement effort to explain risks versus benefits and build consensus before deciding whether and how to progress beyond the first phase;
- Physical trials (including the 'prototype' project presented in the FS),
- further studies and monitoring to inform the phased approach; and
- the development of end-of-pipe mitigation measures as may be required.

This is discussed in more detail later in this report.

BACKGROUND AND CONTEXT

For around the past 4,000 years the Dead Sea water level has fluctuated gradually in the range of -370 m and -411m below mean sea level, due to natural climate variability. Over the past 40 years, however, the water level has dropped from around -397 m (in 1968) to -426 m (in 2012). The decline in water level has resulted in environmental damage including changes to the landscape due to the loss of water surface area, the development of collapse sinkholes in surrounding land and the subsidence and undermining of adjacent infrastructure.

The level of the Dead Sea has declined because the historical annual Jordan River flow of about 1,300 MCM/year has been progressively reduced by upstream diversion – mainly by Israel, Jordan and Syria. This upstream diversion came in response to mounting demand for water driven by the rapid increases in population and economic activity since the 1950s. The main drivers were the allocation of potentially potable water, first to irrigation and secondly to provide the water services of the growing populations. The demand for potable water will continue to increase for municipal and industrial uses. The decline is also caused by significant consumption of Dead Sea water as a raw material for the large chemical industries in Israel and Jordan at the southern end of the Sea. This is estimated to be about 262

MCM/year, which represents about 26 percent of the estimated total outflows from the Dead Sea, with evaporation of 754 MCM/year the comprising the balance.

In response to this situation, Israel, Jordan and the Palestinian Authority developed a shared vision of a Red Sea–Dead Sea Water Conveyance with objectives as follows:

- save the Dead Sea from environmental degradation;
- desalinate water/generate energy at affordable prices for Jordan, Israel, and the Palestinian Authority; and
- build a symbol of peace and cooperation in the Middle East.

A Feasibility Study (FS) being conducted in parallel with the ESA has investigated the engineering options and costs associated with constructing a water conveyance that would carry water from the Red Sea to the Dead Sea and, in so doing, stabilise or increase its water level (the 'base case'). In addition the FS has examined the provision of desalination and electricity generation capacities that, in conjunction with the conveyance, could be used to supply fresh water to users in Jordan, Israel and the Palestinian Authority (the 'base case plus').

The ESA involves a comprehensive review and assessment of all the potential environmental and social impacts of the proposals generated by the FS (both positive and negative) at both the regional and project-specific level.

Definition of the Scheme and its Area of Influence

The FS examined three main options for conveying Red Sea water to the Dead Sea, as follows:

- a buried pipeline;
- a tunnel starting at 0 m elevation (the 'low-level tunnel'); and
- a tunnel and canal system at 220m elevation (the 'high-level tunnel').

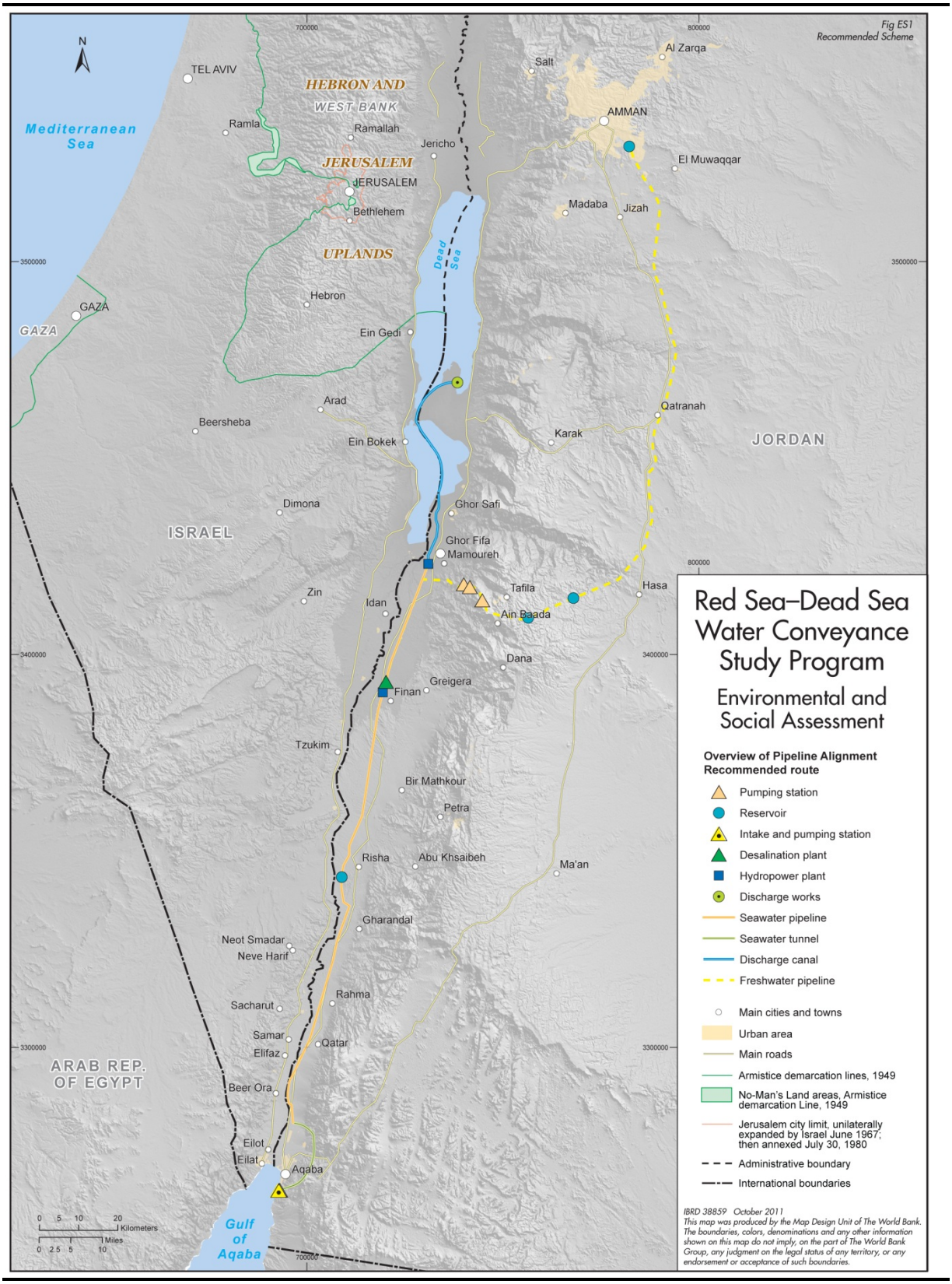
The FS also examined a number of options for siting the various components of the Scheme identifying a Recommended Scheme based on cost and other feasibility criteria The ESA examined all the variants presented in the FS and compared them from a purely environmental and social perspective with the Recommended Scheme. The Recommended Scheme for the RSDSC as identified in the FS is set out in *Figure ES.1*.

For the Recommended Scheme, an intake will be established in the Gulf of Aqaba from which 2,000 Mm^3/year of seawater will be conveyed along the Wadi Araba/Arava Valley, in a series of pipelines buried along the valley floor, together with a short section of tunnel around Aqaba. The conveyance alignment lies entirely within Jordanian territory, and will carry the seawater

for around 140 km northwards to a hydropower plant (HPP) and desalination plant (DSP) in the vicinity of Fedan. Initially, some of the seawater water will by-pass the DSP, to allow faster infilling of the Dead Sea. However, the FS presents some possibilities of developing the project in stages. In at least one of these only reject brine from the desalination process will flow to the Dead Sea.

The DSP will operate by reverse osmosis and its capacity will be expanded in phases until eventually all the water will be desalinated. The brine from the desalination process will combine with any water which by-passes the plant and will continue towards a second HPP located in the vicinity of Ghor Fifa. The outflow from the HPP will continue in a series of buried pipes and open channels, and eventually be discharged to the Dead Sea.

Figure ES.1 Recommended Scheme Layout



Freshwater conveyances will be constructed to take the potable water from the DSP to different locations in Jordan, and possibly also in Israel and the Palestinian Authority. The eastern freshwater line will rise up the escarpment in the Jordanian southern Highlands, passing south of Tafila before turning north to follow the approximate line of the Desert Highway, terminating in the southern outskirts of Amman. A line (or lines) will cross the border to provide water to Israel (probably to tourism facilities and residential communities in the Dead Sea basin and/or Wadi Araba/Arava Valley) and to the Palestinian Authority (at locations to be determined).

At the feasibility stage, elements of the RSDSC to be studied include the 'Recommended Scheme', that is the optimum technical and financial scheme configuration as assessed by the FS, as well as those project level alternatives that have been found technically viable by the FS.

Elements assessed by the ESA therefore include:

- an intake on the Gulf of Aqaba including a pumping station, and a tunnel around Aqaba to the beginning of the pipeline;
- a seawater pipeline to carry Red Sea water to the Dead Sea Basin through the Wadi Araba/Arava Valley;
- a desalination plant and a hydroelectric power plant in the northern Wadi Araba/Arava Valley, close to the Dead Sea basin;
- a second hydroelectricity power plant in the Dead Sea Basin receiving sea water from the pipeline and/or brine from the desalination plant;
- freshwater transmission pipelines, with associated pumping and energy supply infrastructure, to carry water from the desalination plant to demand centres within the three Beneficiary Parties;
- an alternative site for the intake, alternative conveyance options (a low level tunnel and a high tunnel with open canal sections), and alternative sites for the desalination plant; and
- a phased alternative, whereby the Scheme is constructed in four phases over a period of around 30 years.

Impacts have been assessed throughout the Area of Influence of the RSDSC. This takes into account:

- the physical extent of the proposed works, defined by the limits of land to be acquired or used temporarily or permanently for the construction and operation of the Scheme; and

- the nature of the baseline environment, the source of impact and manner in which the impact is likely to be propagated beyond the Scheme itself.

Impact Assessment Methodology

The Assessment has been conducted in accordance with World Bank Operational Policy 4.01 on Environmental Assessment and other relevant Safeguard Policies. The assessment has considered both positive and negative impacts on all aspects of the physical, natural, cultural, social and socio-economic environment.

The assessment has addressed impacts with different temporal characteristics (permanent impacts, temporary impacts, long-term impacts) and both routine impacts and non-routine impacts (ie those arising from unplanned or accidental events or external events).

Induced impacts, ie those caused by stimulating other developments to take place are also considered in the assessment, as are cumulative impacts with other developments taking place in the area at the same time.

The definition of these degrees of significance has been expressed in terms of design response as follows:

- *Critical:* the effect on a sensitive receptor is so severe as to be unacceptable (either because it breaches standards or norms relating to human health and livelihood, or causes irreversible damage to a valuable asset or resource) and mitigation is unlikely to change this;

- *Major:* the effect on a sensitive receptor must be mitigated, either because it breaches relevant standards, norms, guidelines or policy, or causes long-lasting damage to a valuable or scarce resource;

- *Moderate:* the effect on a sensitive receptor is either transient or mainly within currently accepted standards etc, but should be mitigated to ensure that the effect does not become significant by virtue of cumulation or poor management; and

- *Slight/none:* the effect is temporary, of low magnitude, within accepted standards etc, and of little concern to stakeholders.

There is no statutory or agreed definition of significance; however, for the purposes of this assessment, the following practical definition is used:

An impact is significant if, in isolation or in combination with other impacts, it should, in the judgement of the ESA team, be reported in the ESA Report so that it can be taken into account in the decision on whether or not the Scheme should proceed and if so under what conditions.

This recognises that evaluation requires an exercise of judgement and that judgements may vary between parties involved in the process (regulators, funders, assessors, affected people, and the general public). The evaluation of impacts that is presented in this report is based on the judgement of the ESA Team, informed by reference to World Bank Operational Policies, legal standards, policies of the Beneficiary Parties, current good practice and the views of stakeholders as expressed through the consultation process. The procedure followed is transparent such that, using the data presented in the ESA report, it can be replicated independently by other groups, who may wish to test the findings.

Environmental and Social Context

The study area is centred around the stretch of the Great Rift Valley running north to south from the Dead Sea Basin through the Wadi Araba/Arava Valley to the Gulf of Aqaba. To the east and west the valley rises into a range of primarily sandstone hills. The escarpments are cut by wadis (valleys and semi-dry river basins).

The Wadi Araba/Arava Valley floor is characterized by an alluvial dune-field, sandy over much of its length, becoming more stony in some areas. There is some sparse natural vegetation along the valley floor, concentrated along the paths of the flood flows from the wadis. The study area is sparsely populated, with substantial communities only at the edges, Aqaba and Eilat on the Gulf coast, Ein Bokek and Ghor Safi in the Dead Sea basin, and Jericho to the north of the Dead Sea. In the Wadi Araba/Arava Valley there are a number of small villages on the east, and some more developed intensive agricultural communities on the west. Most of the study area is semi-arid (rainfall less than 75mm/year) with average daily temperatures from 19 to 40^{o}C on the floor of the valley.

The region has historically been of strategic economic importance, providing land trade routes between Africa, Europe and Asia and there are many places and features important to the three Abrahamic religions. The Dead Sea itself is a globally unique site, both as the lowest place on earth, and as the saltiest natural body of water on earth. Tourism – health, cultural and religious - makes a very important contribution to the economies of the area, as does mineral extraction (primarily potash and bromide) from the Dead Sea.

A combination of the upstream extractions of fresh water from the Jordan River system, as well as the process of evaporation of Dead Sea water by the chemical companies to produce marketable minerals, has resulted in a significant reduction in the volume of the Dead Sea, causing the surface level to drop. This has led to an increase in the groundwater gradient around the basin, as well as the formation of sinkholes in areas around the shoreline. These have affected the tourism industry around the Dead Sea as well as the ecological balance in the side wadis.

It is within this context that the RSDSC Scheme is derived. In accordance with the 3 main aims of the Scheme (Terms of Reference page 1), the Scheme addresses the desire to preserve the unique economic and cultural importance of the Dead Sea, the growing water demand of the populations in the area, and the need to build a symbol of cooperation and improved relations between the parties.

No Project Scenario

The 'No Project Scenario' is a projection of future conditions that would be likely to develop if no action were taken to address declining Dead Sea levels. The main anticipated effects are summarised in *Table ES.3*.

Assuming no major changes in inflows, and the potash industries continuing their planned production (1), it is estimated that the Dead Sea surface level will fall a further 45m by 2070, with the surface area declining from 605 km^2 to 509 km^2. This is a drop of around 16% of from the 2010 surface area, and means that the surface area in 2070 will be just over 60% of the pre-decline area of the northern basin. The projected difference in the surface area of the Sea between 2010 and 2070, if the Scheme does not go ahead, is illustrated in *Figure ES.2*. If the industries continue operations after 2070, the surface level will continue to fall at a rate of 1 to 1.2 m/year, reaching a level of -550 m by 2150. If the industries cease operations within the next few decades, the Sea will stabilise naturally at a level of around -515 m, at around 300 years from now. In either case, with decreasing surface elevation, the area will continue to shrink beyond 2070.

CONSULTATIONS

A Public Consultation and Communication Plan (PCCP) was developed and a series of stakeholder consultations was undertaken, on behalf of the Beneficiary Parties, in conjunction with the FS Team, following a process of stakeholder identification and mapping. Consultations were held in 2 phases; Phase I was held between June 2008 – July 2009, with the purpose of introducing the Scheme concept and the study process, and discussing key issues and concerns of the parties; Phase II was held between August 2009 and March 2011, once information was available from the Feasibility Study on the various options and outline design of the Scheme. The purpose of the second phase was to present the Scheme options in more detail, including locations and siting of the components, and to present and discuss the proposed means of mitigating the concerns, and hear any further concerns. A third phase will disclose the draft final reports of the Feasibility and ESA studies and the Dead Sea and Red Sea modelling studies, and will continue throughout any further development of the Scheme.

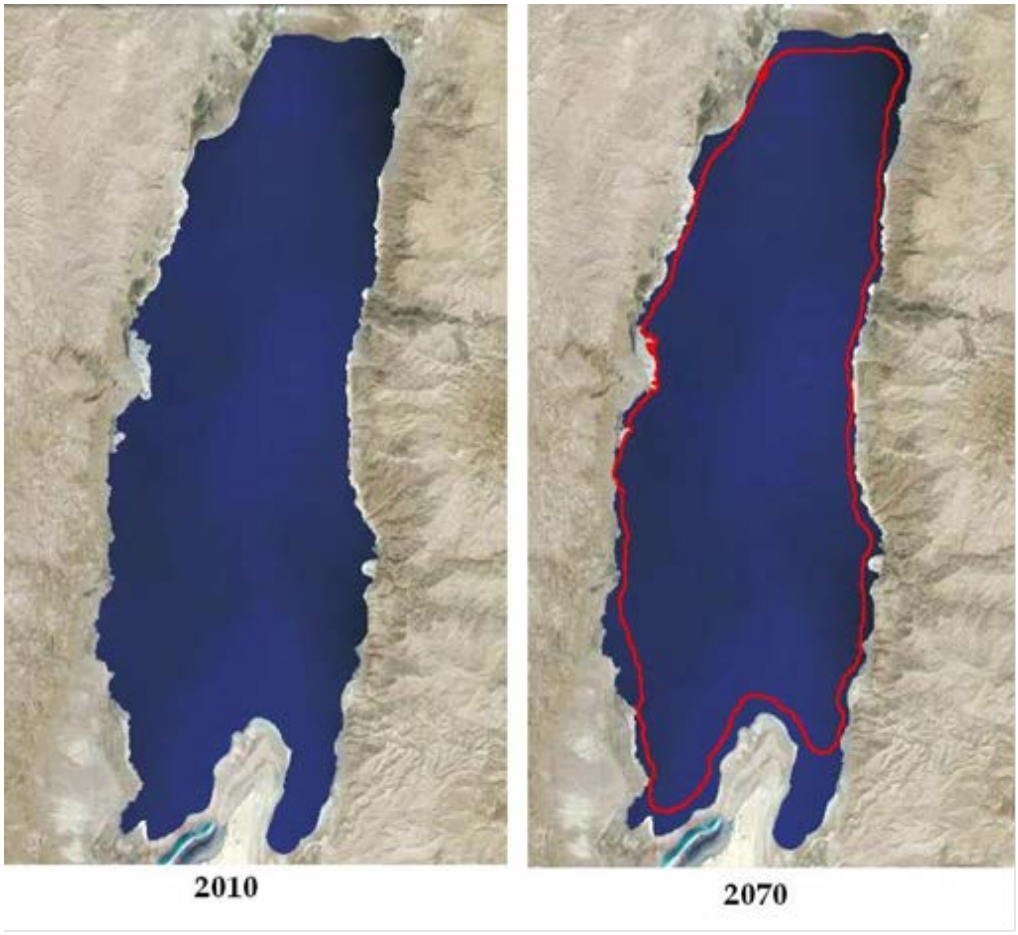
(1) Note that these industry plans (and hence the 'no project' scenario) include a significant increase in production levels over the next decade or so – as discussed in *Section*A3.2.2 of the main ESA report.

Table ES.3 Summary of Changes Expected in the 'No Project Scenario'

Key Issues	Change in No Project Scenario (2010 -2070)
Decline of Surface Level etc	Assuming the industries continue to operate, the level falls by an estimated 45 metres, exposing 96 km² of surface (1). Surface area declines by 16%. The reduction of surface area and the fall in level both continue 2070 regardless of whether the industries continue to operate or not, albeit at different rates.
Sinkhole Formation	Large number of new sinkholes form, mainly clustered along a narrow coastal strips along the western southern coasts of the Dead Sea, especially in the newly exposed surfaces
Dead Sea Ecology	Existing biota (small numbers of salt tolerant unicellular organisms) eliminated. Occasional blooms after flooding
Terrestrial Ecology	Continued decline of small oases in the western hills, associated with springs.
Infrastructure	Damage of the roads, bridges, and drainage channels on the Dead Sea perimeter due to undercutting by creek entrenchment. Possible damage due to sinkholes in roads and agricultural land
Chemical Industries	Continued operation with periodic costs incurred to relocate abstraction points and increased costs of pumping.
Tourism	Costs imposed on the industry to maintain access to the sea. Such costs, even if fully passed, on are unlikely to affect the predicted growth in visitor numbers significantly.
Cultural Heritage Value of the Area	No significant change in the short or medium term
Groundwater resources in the Dead Sea Basin	Continued lowering of groundwater levels in all 3 BPs.
Social Conditions and Livelihood	More employment in tourism, more development around the north east shoreline for leisure, tourism and recreation.
Potable Water Resources	Increased water stress in Jordan and the Palestinian Authority. Inescapable need to develop new water supplies for Amman, the Palestinian Authority and surrounding areas.
Microclimate	Increasing aridity in the Dead Sea Basin, decline of air water content (humidity). No evidence for changes in dust storm frequency or severity.

(1) Note that these estimates have been extracted from the latest FS Draft Final Summary Report, dated September 2011. The Final DSMS report dated August 2011, however, suggests a larger decline.

Figure ES.2 Shrinkage of the Dead Sea in the No-Project Scenario



Note: the estimated 2070 shoreline contour shown in red has been derived from the FS predicted sea level and the interpolation of bathymetric information presented in Hall, J.K. (1996). Topography and bathymetry of the Dead Sea depression. Tectonophysics, 266: 177-185. It is therefore only a provisional approximation based upon available data, awaiting a map from the DSMS derived from detailed bathymetric data held by GSI.

Each phase of consultations was held at three levels. Publicly advertised meetings were held at a 'central level' in each of the Beneficiary Parties to allow all interested parties to hear about and participate in the Scheme. A series of bilateral consultation meetings was also held, with government bodies, statutory consultees, NGOs and research institutions, industries, and other technical groups. Details of meetings, including questions raised and answers given were made available on the study website (www.worldbank.org/rds).

Public concerns during consultation varied markedly between the three Beneficiary Parties, as follows.

- In the Palestinian Authority, there were some technical concerns related to the mixing of the two waters and the impacts on ecology and of seismic/flood risk in the Wadi Araba. However, most concerns related to the current lack of Palestinian access to the Dead Sea, and on Palestinian water rights and control of water resources, and on the implications of this

study and the Scheme on those. Additionally there was concern that acceptance of the RSDSC would foreclose strategic alternatives to managing the Dead Sea level, some of which (ie those that might restore the Jordan Valley) might better serve the needs of current and future residents.

- In Israel, by far the most consistent issue was the lack of a study of alternatives that would address whether other strategic solutions were preferable to the RSDSC. Technical concerns related to the mixing of the two waters; induced development of the desert areas; and, salt water contamination of aquifers close to agricultural production areas in Wadi Araba/Arava Valley. There was also interest in the governance and control of the proposed project, and in the cooperation of the three beneficiaries during the study phase.

- In Jordan, interest focused on the freshwater to be produced – the quantities and its distribution and allocation. There was also interest in the precise route, the nature and duration of disturbance during construction, resumption of land distribution halted in anticipation of this project, local employment opportunities from this project, leakage risks, and Jordan's role in a joint project.

In addition a number of issues were raised by groups with specific interests or concerns including the following:

- *Ecology:* it was generally accepted by regional professionals that the risks associated with the Scheme would be manageable but that extra assurance should be provided by taking advantage of opportunities to improve knowledge and increase regional cooperation through establishment of transboundary corridors, studies, and monitoring.

- *Chemical industry planning:* the industries that are extracting Dead Sea water for production of chemicals were concerned that uncertainty about the future mixing regime and hence, the chemical and physical characteristics of their intake water, would hinder their production planning, as well as potentially reducing yields.

REGIONAL IMPACT ASSESSMENT

Regional impacts are defined as those with '*broader environmental and social impacts with reference to both existing and future conditions*'. We have determined that the Scheme could have regional impacts as a result of: i) the sheer magnitude of the Scheme; ii) the regional and global geo-political context; iii) the unique cultural context of the region; and iv) the context of severe water scarcity in the region. In other words, regional impacts are those which arise from the presence of the Scheme itself, or which have a bearing on the broader context of the region.

For the purposes of the ESA, regional impacts have been examined under the following broad headings that incorporate relevant potential environmental and social impacts and interpret them in a regional context:

- Regional economic development
- Cultural and natural heritage
- Water demand and water resources
- Energy demand and climate change
- Induced impacts

There may also be implications for regional relations and peace building. This issue is addressed in the Feasibility Study.

Regional Economic Impacts

The wider economic context is one of expectations of reasonably steady growth over twenty years which could bring Jordan to the income level of a middle income country and double per capita income in the Palestinian Authority. Growth prospects for Israeli are also optimistic, with the IMF World Economic Outlook (IMF, 2011) envisaging annual GDP growth of between 3.3% and 3.8% between 2012 and 2016. In terms of resource use, such growth in the region will see a substantial increase in demand for water. The impact of the Scheme will be to enable the increased demand for domestic water supply – particularly in Jordan – to be met without further over exploiting groundwater.

If the Scheme were not to go ahead, the decline in the level of the Dead Sea will undoubtedly have a negative (although not disastrous) impact on tourism. However, the Dead Sea is only one component of the tourism product in the region, and historical sites, heritage and leisure are also important components of the tourism product. Health tourism will bear a greater impact than leisure tourism of a continuing decline in the level of the Dead Sea, as it is directly affected by access to the Sea itself, but in practice it is only makes a small contribution to GDP - less than 0.4%. The present uncertainties about the outcome following implementation of the Scheme (a stabilised Dead Sea level, but with possible algal blooms and gypsum suspension, see below) make the balance between the 'with project' and 'without project' unknown until more analysis establishes the potential effects of the Scheme on Dead Sea water quality with greater confidence.

In the industrial sector, there are potential benefits and disbenefits to industry from the stabilisation of the Dead Sea. The Scheme will have little direct impact on the agricultural sector. This sector is relatively small in terms of economic contribution, and water generated from the project would be unlikely directly to supply the agricultural sector because of the considerably higher cost of SWRO water compared to groundwater, water reuse, etc. So the sector would remain in the same water-constrained position with the Scheme as without it. However, under current policies, any additional

wastewater generated as a result of additional potable water use, especially in the Amman area, would become available to agriculture in the Jordan Valley.

Cultural and Natural Heritage

Figure ES.3 illustrates the amount of land surface in the study area which has a protected status or which is ecologically sensitive.

The Dead Sea is of particular importance at a regional level in terms of both natural and cultural heritage. The criteria used by the World Heritage Organisation for World Heritage status are useful in clarifying the heritage associated with the Dead Sea and the region. The three most relevant criteria are that the resource:

- "*is directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance*" (criterion vi);

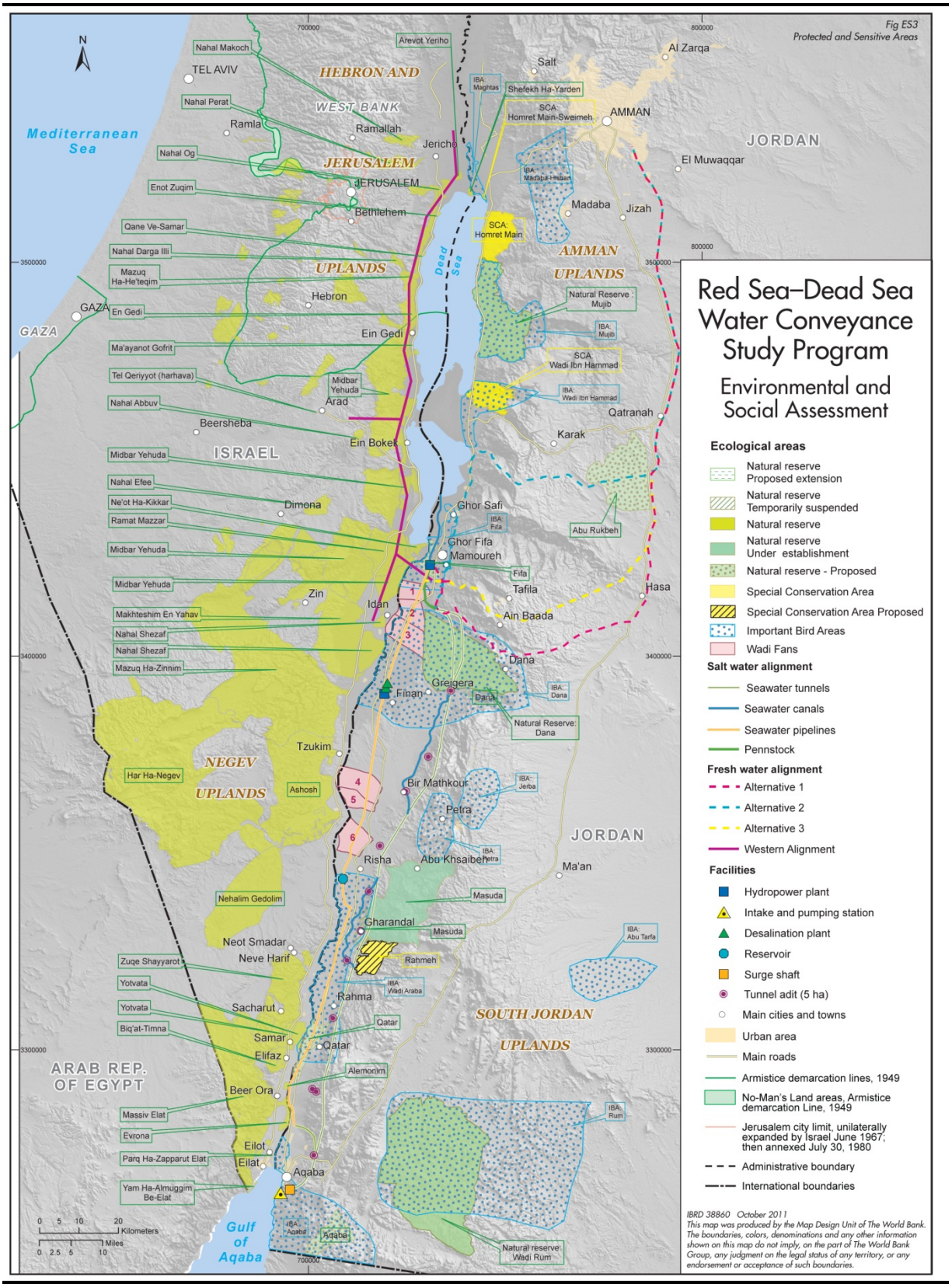
- "*contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance*" (criterion vii); and

- "*is an outstanding example representing major stages of Earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features*" (criterion viii).

The Scheme is proposed to 'save the Dead Sea', but in the process of restoration there is a risk that the attributes reflecting the two latter criteria presented above could be undermined. Although the Dead Sea Modelling Study has been unable to determine their precise likelihood under all possible conditions (1), the effect of visible and persistent gypsum precipitation or future blooms of browny-green algal mass, if dramatic enough, could unacceptably change the nature of the 'exceptional natural beauty'. The changing of the chemical composition of the sea could also change the perception of its representation of major stages of the Earth's history (although it could be argued that the mining of minerals and abstraction of water by industry over the past 40 years has already done that). Because of the uncertainties regarding these effects, their potential impact on cultural and natural heritage is considered to be of major significance.

(1) See DSMS Final Report, August 2011

Figure ES.3 Protected and Sensitive Areas in the Study Area



The Dead Sea, lying in the Great Rift Valley, is also very important as a flyway for migratory soaring birds in the Africa-Eurasia flyway system, although the RSDSC is not expected to have any significant impact on this natural heritage issue.

Water Resources and Demand

One of the objectives of the Scheme is to address the water deficit in the region and it will clearly be able to do this. The Scheme has been designed to address specifically the water deficit up to the year 2060 in the Amman, Zarqa, Madaba and Karak areas – the areas which are most likely to be able to be economically supplied by the Scheme - as well as supplying water to areas in the Palestinian Authority yet to be identified, and also to as yet unidentified areas in Israel in the Wadi Araba/Arava Valley. The provision of desalinated water to Jordan will relieve pressure on the Jordanian aquifers and will be able to contribute to reducing water stress in the other Beneficiary Parties, a vital and positive impact.

Energy Demand and Climate Change

The Scheme will require a substantial net increase in power generation, reaching 803 MW by 2060 from 354 MW in 2020, and by 2060 the demand from the Scheme will be about 44% of Jordan's current (2008) energy usage.[1] Although detailed plans have not yet been finalised, preliminary project planning indicates that energy use will be a substantial element of the final cost of fresh water.

In the regional assessment the focus is on the impacts of additional resource use from increased power generation, and consequent emissions and climate change impacts.

The level of resource depletion is likely to be significant; and while efforts to increase the share of renewable energy sources (the target of the energy ministry is to produce 10% of electricity from solar and wind power by 2020) through modernisation of the sector will mitigate the impacts, nonetheless significant non-renewable resources will be used.

In terms of GHG emissions, it is estimated that by 2060 emissions from the power generation needed for the Scheme will range between 2,780 – 4,369 thousand tonnes equivalent of CO_2 per year (depending on the final energy mix). This impact is permanent and irreversible. Although the magnitude is slight in global terms, at between 34 and 53% of Jordan's 2008 GHG output (depending on the final energy mix and efficiency measures), the regional impact is nevertheless of major significance.

[1] The hydropower plants associated with the scheme will have about 300 MW installed which will help offset the total energy requirement.

Induced Impacts

The major induced impact will be the benefit from the reduction of over-abstraction of Jordan's aquifers. In addition, there is a concern that over-development in the Wadi Araba/Arava Valley could be detrimental to its integrity. The RSDSC as currently envisaged is unlikely to induce development in the Wadi Araba/Arava Valley, however, since it is not intended to provide freshwater to the area. Planned future development is mostly small-scale quality tourism.

Conclusions of Regional Assessment

As discussed earlier, the regional assessment has focussed on a number of broad-level issues that incorporate the various environmental and/or social impacts that are relevant to the Scheme at the regional level. These regional impacts, their significance and possible mitigation measures are summarised in *Table ES.4*. In summary, at a regional level the greatest concern and risk lies with the possible change to the nature of the Dead Sea itself which could cause a loss of cultural and natural heritage. This risk is discussed in more detail in the next section, along with other project-level impacts on the various environmental and social receptors in the study area.

PROJECT-LEVEL ENVIRONMENTAL AND SOCIAL ASSESSMENT

The project-level environmental and social assessment has been structured according to a range of thematic areas in the main PESAR as follows:

- *Section C2*: The Dead Sea
- *Section C3*: The Red Sea
- *Section C4*: Hydrology and flood risk
- *Section C5*: Archaeology and cultural property
- *Section C6*: Social assessment
- *Section C7*: Landscape and visual
- *Section C8*: Terrestrial ecology
- *Section C9*: Hydrogeology
- *Section C10*: Public health
- *Section C11*: Nuisances and disturbances
- *Section C12*: Major hazards
- *Section C13*: Assessment of alternative configurations

This following sections summarise the assessment of impacts under each of these headings, including their likely significance both before and after the recommended mitigation measures developed for the ESMP.

Table ES.4 Summary of Regional Level Impacts and Mitigation

Impact	Significance (pre mitigation)		Mitigation
	Description	Rating	
Impacts on Regional Economy			
Benefits from the availability of additional freshwater	One of the objectives of the Scheme. A *sine qua non* of the Scheme, and therefore a major positive impact.	●	-
Impacts of job creation	Not significant as a regional impact	O	-
Impacts on tourism	Not significant as a regional impact except at the Dead Sea. Possibly moderately positive with respect to the No Project Scenario, but risk of major negative.	●	Phased approach with further study and information campaign.
Impacts on Industry			
Risk to the extraction industries at the Dead Sea	Possibly major impact, depending on effects on Dead Sea (see project level impacts).	●	Phased approach with further study and information campaign.
Benefit to the industries	A possible net benefit to the industries from the increased water level, assuming negative impacts due to water quality changes are mitigated.	●	-
Impacts on agriculture	Risk that additional water availability reduces incentives to increase water use efficiency. Assessed as minor/not significant, since water produced by Scheme is not destined for agricultural usage, and any effect will be indirect (and potentially positive through re-use of treated wastewater). Also, industry is currently going through efficiency improvements.	O	-
Impacts on the Dead Sea Basin as a Heritage Site			
Changes to the perception of the Dead Sea basin as a regional and international heritage site, due to changes in water quality or appearance	Potentially a major impact. Future modelling studies informed by results of a pilot ('prototype') project will provide opportunity to investigate and develop management/response measures before critical damage is done.	●	Phased approach with further study, including a pilot (prototype) project and information campaign.
Impacts on Natural Heritage of the Wadi Araba/Arava Valley			
Impacts on the ecological heritage value, eg from nuisances during construction, breach in ecological connectivity, or impacts on migratory birds	Not regarded as a regional impact due to the temporary nature of the impact sources, and the low magnitude at a regional level	O	-
Impacts from the provision of potable water	Reduction in the water supply deficit especially in Jordan. Reduction of environmental deficit by reducing pressure from over pumping from the aquifers	●	
Energy use and Greenhouse gases			
Economic impacts of additional power generation	The costs of energy provision are factored into the operational cost of the Scheme and therefore the cost of water produced, as determined by the FS. The	●	See Feasibility Study.

Impact	Significance (pre mitigation)		Mitigation
	Description	Rating	
	financibility of the Scheme and affordability of water are considered vital pre-conditions for the Scheme's feasibility.		
Impacts from resource depletion	Quantities – amounts and proportions to be determined by the Jordan National Electric Power Company (NEPCO) - of either heavy fuel oil, natural gas or uranium ore will be used up in the energy generation necessary for the Scheme's operation.	🔴	Maximise energy efficiency in the Scheme design and operational procedures. Conduct a sectoral level Strategic Environmental Assessment of Jordan's energy sector and *Energy Master Plan*.
Impacts from GHG emissions	Since the Scheme will have a large energy demand and will exceed the IFC Performance Standard threshold for GHG emissions by between 21 and 34 times, it is considered a major impact.	🔴	Off-setting of GHG emissions in detailed design, including energy efficiency measures, carbon financing, use of carbon neutral/renewable energy sources.
Induced impacts			
Induced development of the Wadi Araba/Arava Valley	No significant developments have been identified as likely to be induced by the Scheme in its current form. No closed areas will become newly accessible as a result of the Scheme. The local workforce will not be significantly up-skilled as a result of the Scheme	O	
Expansion of Jordan's energy and transmission capacity	Jordan has areas designated for development. No indications that grid strengthening for Scheme will induce other impacts in those areas.	O	
Benefits from restoration of the Jordanian aquifers	One of the most significant benefits of the Scheme is the reduction of over-pumping from Jordan's aquifers and the possibility of their eventual restoration.	🟢	
Benefits from the provision of additional freshwater	The Scheme will allow the reduction and removal of Jordan's water supply deficit, and the meeting of various environmental and social objectives in the Water Strategy. A potentially major positive impact.	🟢	
Impacts from the provision of potable water	Reduction in the water supply deficit especially in Jordan. A potentially major positive impact.	🟢	

Key:

🟢 **= positive;** O **= slight/none;** 🟠 **= moderate;** 🔴 **= major**

The Dead Sea

The potential impacts and mitigation measures identified by the study for the Dead Sea's limnology and surrounding environment are summarised in *Table ES.5*, together with the likely significance of impacts before and after the proposed mitigation measures (1).

Table ES.5 Summary of Dead Sea Impacts and Mitigation

Potential issue/impact	Mitigation	Significance Pre mitigation	Significance Post mitigation
Effects of Construction in the Dead Sea			
Increase of suspended sediments	Good environmental management of construction	O	O
Visual Appearance and Aesthetics of the Dead Sea			
Shore and sea bed uptake	Additional measures not necessary	O	O
Stabilisation of the water level	Additional measures not necessary	🟢	🟢
Natural and Cultural Heritage of the Dead Sea Area			
'Integrity' of the Dead Sea as a Heritage Site	• Additional study, including analysis of information gained from physical trials etc • Effective communication and phased approach with upscaling dependent on clearer understanding of risk and testing of additional mitigation	🔴	🟠
Water Quality (appearance, blooming)	• Additional Study, including analysis of information gained from physical trials etc	🔴	🟠
Accumulation of chemicals from desalination	Pollution control of desalination plant effluent	🔴	O
Groundwater and Hydrogeology			
Groundwater availability	Additional measures not necessary	🟢	🟢
Surrounding wildlife	Additional measures not necessary	🟢	🟢
Tourism and Health Industry			
Presence of Dead Sea	Additional measures not necessary	🟢	🟢
Conditions for swimming	Additional measures not necessary	O	O
Visual impacts (Dead Sea colour)	• Additional Study, including analysis of information gained from physical trials etc • Effective communication with industry stakeholders	🟠	🟠
Dust from mudflats	Additional measures not necessary	🟢	🟢
Therapeutic effects	Change location of intake	🟠	O

(1) Note, the assessment of impacts and their significance where appropriate draws upon the results of the DSMS (as detailed in the DSMS Final Report, August 2011). For example, the potential risk of atmospheric hydrogen sulphide releases was considered by the DSMS as unlikely to be significant and only relevant to chemical industry workers as occasional bad odour.

Potential issue/impact	Mitigation	Significance Pre mitigation	Significance Post mitigation
Chemical Industry			
Reduced efficiency of industrial evaporation ponds (gypsum, microclimate)	Additional measures not necessary	O	O
Direct operational costs (associated with moving intakes and pumping)	Additional measures not necessary	●	●
Uncertainty in planning and design	• Additional Study, including analysis of information gained from physical trials etc • Effective communication with industry stakeholders	●	O
Work environment (odour of Hydrogen Sulphide)	Monitoring and potential provision of masks	O	O
Infrastructure and Material assets			
Sinkholes	Additional measures not necessary	●	●
Wadi incision	Additional measures not necessary	●	●
Adaption of infrastructure to changing water level	Additional measures not necessary	●	●

Key:

● = positive; O = slight/none; ● = moderate; ● = major

The assessment of significance identifies several potentially major negative impacts on the Dead Sea area, all of which arise from the same set of causes that may be summarised as follows:

The mixing of the Red Sea water/brine with the Dead Sea may give rise to changes (chemical, physical and biological) that affect the water quality of the Dead Sea in a way that is perceptible to users and other stakeholders.

In particular, based upon the findings of the DSMS (1) there is still some degree of uncertainty about the likely scale and duration of the following potential impacts on the biophysical characteristics of the Dead Sea, which may occur separately or in combination.

- Gypsum (solid Calcium Sulphate) will be precipitated in a powdery or a colloidal form and may rise to the surface of the Dead Sea or persist in the water column, imparting a 'milky' appearance to the water.

- There may be occasional blooms of green algae and cyanobacteria, successively imparting green and red colouring to the Dead Sea water (as in experimental ponds, albeit with added phosphate), and in some cases

(1) As detailed in DSMS Final Report, August 2011.

forming masses of floating brownish-green polysaccharide slime that accumulate in the water.

The DSMS has not been able to definitively predict the likelihood or extent of these effects over the full range of inflow conditions that will be encountered during the Scheme. The study results (1) suggest that when gypsum is precipitated, essential nutrients (phosphate, iron) may be co-precipitated and thus not be available for biological processes in the upper layer of the Dead Sea. In this case it is possible that the extent of algal and archaeal blooms in the Dead Sea would be rarer than hitherto.

Nevertheless, it is likely that some whitening and some blooming will be observed for periods during the lifetime of RSDSC.

Despite the uncertainty, the possible dimensions and consequences of some of the effects arising from the DSMS indicate the following.

- There will be precipitation of gypsum causing increased turbidity of the water column, in severe cases appearing as whitening of the Dead Sea (depending on the physical characteristics of the gypsum particles).

- The most acute affects may be near the mixing interface, the entire Dead Sea may not always be affected at any one time, but there can be rapid lateral mixing in the surface layer, so that, the effects may span most or all of its surface area.

- Biological effects (blooming of algae and cyanobacteria) may occur if stratification develops and the upper mixed layer is diluted by at least 10%, which becomes more likely as greater volumes of seawater/reject brine are introduced into the Dead Sea (1).

- Unusual events such as extreme weather and non-routine operating conditions may trigger any of these effects, with a magnitude and in circumstances that modelling might not have foreseen.

Such effects would be different from the current situation and the 'No Project' scenario; however, in large part they represent a return to the situation as it was before the 1979 Dead Sea turnover, when it was permanently stratified and experienced more pronounced seasonal blooms than today. Additionally, the negative effects would be offset by positive consequences of water level stabilisation (shore closer to hotels and roads, reduced area of mudflat, reduced damage to infrastructure, reduced area prone to sinkholes, reduced drainage of groundwater and springs).

(1) In this respect, the DSMS Final Report concludes that the addition of up to 400 MCM/year of seawater/reject brine should have no discernible affect on the limnology of the Dead Sea, particularly in regard to dilution and biological blooming; however the report recommends that further monitoring and research is required to determine the effects of higher inflow volumes.

Acknowledging the aforementioned uncertainty, we may still summarise that the potential effects are occasional deterioration of water quality, sometimes covering all or most of the Dead Sea, manifested in changes in water colour, turbidity, and possibly floating slimy deposits in the waters. This might not be sufficient to significantly affect the current uses of the Dead Sea by visitors. The disturbances would probably be periodic and transitory, or avoidable to visitors by relocating or using the evaporation ponds for bathing (as currently happens at the Israeli Dead Sea tourism centre of Ein Bokek). Hotels might also respond by maintaining pools of Dead Sea water for guests' use (as some already do) or by relocating the intakes for thereapeutic facilities. Other key aspects valued by visitors (the setting, the history, etc) would be unchanged.

The Dead Sea is valued as a heritage site, and for intangible qualities such as peacefulness, health-giving, connection with history, etc (see *Section B4* of ESA Report). The UNESCO Guidelines (1) for management of such sites place emphasis on the importance of maintaining their 'integrity' as manifested by their aesthetic qualities, and the preservation of their ecological and biophysical characteristics. The physical and biological changes potentially induced by the RSDSC (or even – perhaps wrongly - perceived to have been induced) could thus damage the integrity of the Dead Sea. If the changes covered a wide area, were readily apparent to the naked eye, and persisted for longer that a few weeks, the perception of the wider community, including people who have never and do not intend to visit the Dead Sea, could be that it had been damaged by the RSDSC – even though the phenomena have sometimes occurred in the past.

'End-of-pipe' options for mitigation of the effects resulting from the altered biophysical characteristics of the Dead Sea water are highly uncertain. Options such as seeding the inflowing brine with gypsum crystals (to increase the grain size of the precipitated material and speed its deposition to the bottom of the Dead Sea) are plausible but would need to be fully investigated in future studies. Pre-mixing the Red Sea water/desalination plant brine and Dead Sea waters is another option that requires further study (dependent for its effectiveness on, for example, the nucleation time of the gypsum crystals, and of uncertain efficacy against algal blooming) and would require the establishment of large mixing ponds in areas that are already heavily environmentally and socially constrained.

It is therefore essential that further detailed studies are undertaken in follow-up to the DSMS and in advance of construction of the full Scheme. Study of the effects on the Dead Sea should continue, using the results of the pilot ('prototype') project and other physical trials and experiments to further develop and calibrate the numerical models that have been developed (2). If necessary (that is, if the results of the pilot indicate a significant risk of adverse environmental effects) end-of-pipe mitigation measures should be developed and tested. As a further precaution, the development of the Scheme should be phased so that after each phase the accuracy of the modelling preditions

(1) Operational Guidelines for the Implementation of the World Heritage Convention, UNESCO, 2008
(2) The proposed scope for his research is discussed in detail in the DSMS Final Report, August 2011.

and/or the efficacy of the mitigation measures can be assessed and the subsequent phase of the Scheme adjusted accordingly. Assuming that the above measures are properly implemented, the potential effect of RSDSC on the 'Integrity' of the Dead Sea as a Heritage Site, the quality of the Dead Sea water, and the visual appearance to visitors, have been assessed as 'moderate'.

The Red Sea

The potential impacts and mitigation measures identified by the study for the Red Sea's marine and coastal environment are summarised in *Table ES.6*, together with the likely significance of impacts before and after the proposed mitigation measures.

Table ES.6 Summary of Red Sea Impacts and Mitigation

Potential issue/ impact	Mitigation	Significance	
		Pre mitigation	Post mitigation
Impact of water abstraction on water quality in the entire Gulf of Aqaba	Location for the intake is fixed in an area and at a depth where any potential effects are minimised.	O	O
Impact of water abstraction on local water quality of the upper Gulf of Aqaba	Location for the intake to be fixed in an area and at a depth where any potential effects are minimised.	🟠	O
Impact of water abstraction on water level in the Gulf of Aqaba	None required	O	O
Impact of turbidity during construction activities	Good environmental management of construction	🟠	O
Impact of noise/vibration induced by construction	Good environmental management of construction	🟠	O
Destruction of benthic habitats, including coral colonies due to physical presence of the intake	Good environmental management of construction and coral transplantation where appropriate	🟠	O
Impact of water abstraction on Gulf of Aqaba coral population dynamics	Sensitive location of the intake, monitoring	🟠	O
Colonization of pipelines by corals and other fixed benthos (and protections if applicable)	Selection of materials and design to enhance this effect	🟢	🟢
Impacts on local fishing activities	Good environmental management of construction	🟠	O

Key:

🟢 **= positive;** O **= slight/none;** 🟠 **= moderate;** 🔴 **= major**

Impacts on the marine environment that could arise during construction of RSDSC result from:

- the installation of the intake structure and possible destruction of (coral and benthic) habitat;
- the establishment of a temporary exclusion zone around the marine working area;

- the formation of turbidity plumes during dredging and pipe laying; and
- the generation of noise and vibration.

The concerns during the operational period arise from:

- the abstraction of a large volume of water with potential alteration of marine circulation patterns;
- the effect on the quality and physical characteristics of the water body (primarily temperature and salinity) with consequent damage to marine life; and
- the entrainment of aquatic organisms in the abstracted water.

Assuming that, as described in the FS Draft Sub-Study Report, the outcome of the RSMS is used to fix a location for the intake in an area and at a depth where any potential effects are minimised, no significant effect is anticipated on the circulation in the Gulf, either on the water level or on the quality of the water. However, given the level of concern and the incomplete knowledge efforts should continue to understand and model the currents and drivers. A continued monitoring effort is recommended.

Construction impacts can be effectively mitigated by good practice construction methods and modification of the Scheme footprint, where practicable, during detailed design.

The potential for impact of water abstraction on marine life is also small because of the avoidance measures already included in the Scheme design. If need be, additional mitigation measures could further minimize fauna entrainment in the abstracted water.

Compensation for residual damage is recommended by transplanting the coral colonies that would be destroyed and by making sure that, where practicable, the Scheme footprint and structures can provide a habitat for biota.

Hydrology and Flood Risk

The potential impacts and mitigation measures relating to inland surface water hydrology identified by the study are summarised in *Table ES.7*, together with the likely significance of impacts before and after the proposed mitigation measures.

The key surface water issues associated with the RSDSC include:

- the impacts of construction, mainly relating to potential impacts on water drainage, sedimentation, erosion and water quality due to excavation and construction works;

- the impacts during operation, when the interaction between above-ground permanent infrastructure and wadi drainage paths could affect local hydrological regimes; and

- the risk of the uncontrolled release of sea water (or brine) from conveyance breaches due to inadequate or poorly designed cross-drainage structures or indundation of above-ground facilities, and the consequent risk of saline intrusion into downstream aquifers.

Table ES.7 Summary of Surface Water Impacts and Mitigation

Potential issue/ impact	Mitigation	Significance (aggregated for Scheme)	
		Pre mitigation	Post mitigation
Impacts on water quality and drainage conditions during construction	Implementation of standard environmental controls during construction, particularly prior to and during seasonal rainfall periods.	●	O
Impacts on wadi flood pathways	Appropriate design coupled with site Investigation to verify/ calibrate design flood calculations to observed conditions wherever possible.	●	O
Risk of sea water/brine contamination of aquifers from infratructure breaches due to flash floods	Detailed hydrogeological investigations to identify sensitive wells/zones, and possible drilling of monitoring/ interceptor wells.	●	O
Stabilisation of wadi channel beds around Dead Sea.	-	●	●

Key:

● = positive; O = slight/none; ● = moderate; ● = major

All of the construction related impacts can be mitigated very effectively at source by the implementation of standard best practices in terms of environmental controls and management practices, particularly prior to and during seasonal rainfall periods. These would include regular checking and maintenance of all plant and machinery to minimise the risk of fuel or lubricant leakages, the use of dedicated, lined and bunded storage areas for all fuel, oil or chemical stockpiles and the installation of effective site drainage measures. With regard to operations, the detailed engineering design will afford a very high level of flood protection to all of the above-ground facilities and wadi cross drainage structures constructed for the Scheme such that risks relating to the flood indundation or failure will be very small. In addition, there are potential positive impacts due to the stabilisation of bridge and culvert structures in close proximity to the Dead Sea shoreline as the channel bed erosion potential of wadis is stabilised as sea level falls are arrested.

Archaeology and Cultural Property

The potential impacts and mitigation measures relating to archaeology and cultural property that were identified by the study are summarised in *Table*

ES.8, together with the likely significance of impacts before and after the proposed mitigation measures. *Figure ES.4* shows the category 2, 3 and 4 archaeological sites in the Wadi Araba/Arava Valley.

Table ES.8 Summary of Archaeological and Cultural Property Impacts and Mitigation

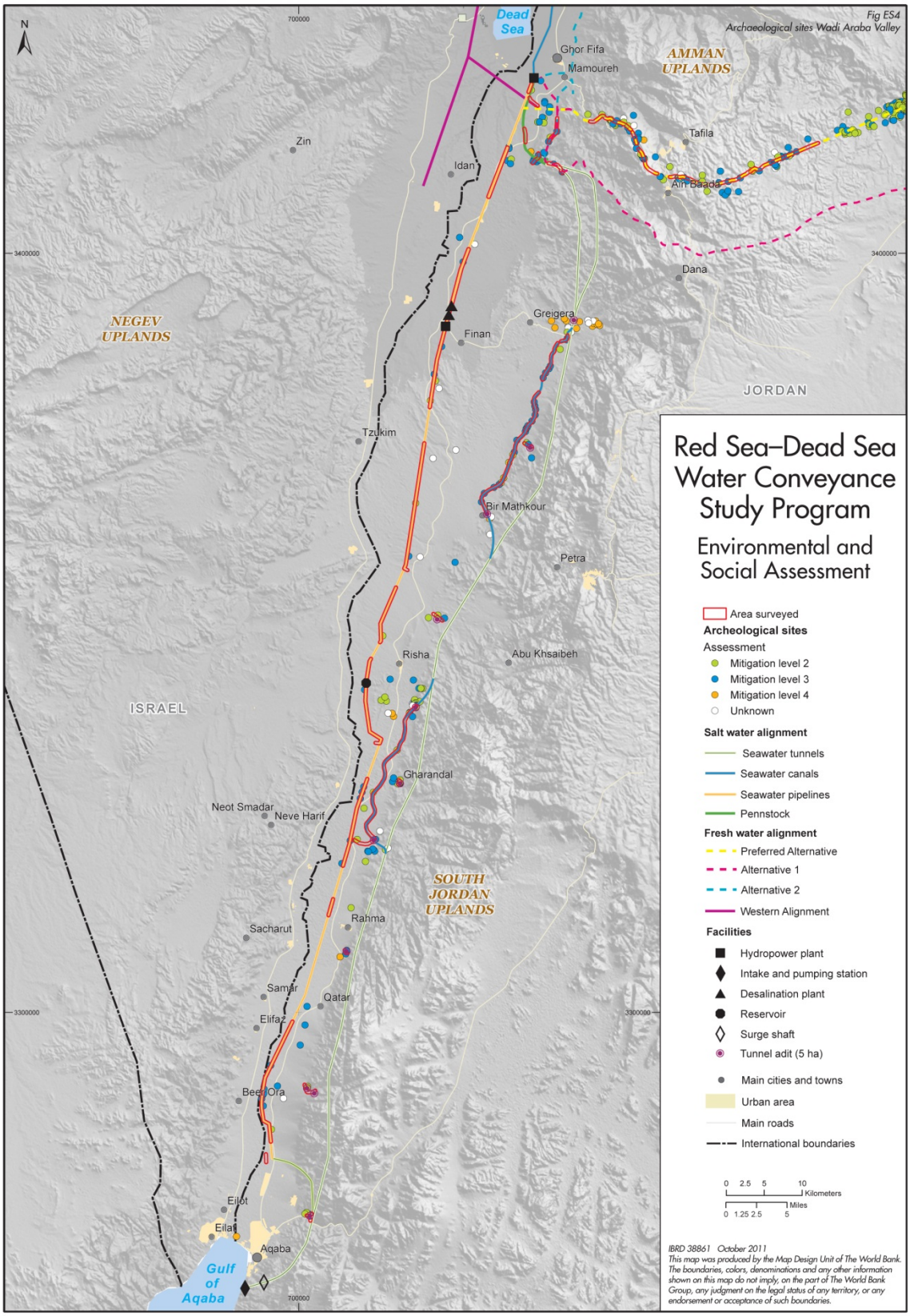
Potential Issue/Impact	Mitigation	Significance	
		Pre mitigation	Post mitigation
Eastern Intake			
Construction activities are not close to any known archaeological sites	Chance find procedures in place	O	O
Construction Activities are not close to any other culturally important sites	Good construction practice to prevent disturbance	O	O
Sea Water Pipeline			
Construction activities close to 15 Category 3 archaeological sites (mainly ancient cemeteries and campsites)	Detailed assessment of all sites followed by either sampling or full excavation	●	●
Construction activities close to four Category 2 archaeological sites (two flint scatters and two enclosures in poor condition)	Collection of samples and recording of the sites	●	O
Construction activities are not close to any other culturally important sites, but major graveyard in vicinity	Good construction practice to prevent disturbance	O	O
Freshwater Pipelines			
Construction activities Close to 29 Category 3 archaeological sites (mainly ancient cemeteries, towers, stone circles and enclosures)	Detailed assessment of all sites followed by either sampling or full excavation	●	●
Construction activities close to 13 Category 2 archaeological sites (mainly walls and enclosures, also some flint and pottery scatters)	Collection of samples and recording of the sites	●	O
Near the village of Ain Baida, the alignment is close to 4 modern graveyards	Good construction practice to prevent disturbance	●	O
Dead Sea Basin			
Construction Activities close to four Category 3 archaeological sites (water channelling system, cemetery, stone circles)	Detailed assessment of all sites followed by either sampling or full excavation	●	●
3 mosques located and 2 graveyards in the vicinity but not close	Good construction practice to prevent disturbance	●	O

Key:

● = positive; O = slight/none; ● = moderate; ● = major

The area through which the RSDSC passes is of great archaeological and cultural significance. There are archaeological remains dating back to the earliest times of human residence in the Middle East and traces of many major civilisations from pre-historic dates up until the modern era. The route will, therefore, pass close to sites of archaeological or other cultural significance and will therefore need to be carefully planned to prevent physical damage or disturbance to these sites. The main potential for impacts is in Jordan: the areas of construction in Israel and the Palestinian Authority are much smaller and are expected to lie within an existing road corridor.

Figure ES.4 Important Archaeological Sites in the Wadi Araba/Arava Valley



Important sites were identified through a literature survey, field surveys and consultation with experts and local people. The academic and heritage value of each site was independently assessed by each member of the field team and assigned a consensus impact assessment value on a scale from 1 to 4 (taking into account the distribution and abundance of this type of site, the condition, inherent value, policy and legal status in the region etc). Each number on the scale corresponds to the value of the site and is linked to commensurate measures recommended to mitigate any potential damage.

Actions that need to be taken to manage and mitigate potential impacts to known sites may be summarised as: avoidance; excavation; mapping and recording; and good practice management of construction activities. In addition, measures must be taken to identify previously unknown sites if the alignment is shifted for any reason and to manage sites that are encountered unexpectedly during construction activities.

Social Assessment

The potential social impacts and associated mitigation measures identified by the study for the RSDSC are summarised in *Table ES.9*, together with the likely significance of impacts before and after the proposed mitigation measures.

An extensive series of community consultations was conducted for the social assessment, as described in Annexes III to V of the Main Report, covering almost all of the villages close to the alternative conveyance and pipeline routes. In addition, discussions were held with social/community experts with experience in the area, academic researchers and NGOs. Research was undertaken of the body of academic work available on the subject. Local and central government agencies were also consulted, as were professional land sales agents with experience in land trading in the area.

Three rounds of local consultations were conducted in all: the first between June and December 2008; the second (conducted in conjunction with the FS Social Sub-Study) between July and December 2009; and the third between July and December 2010. The ESA team's understanding of the social baseline and the various communities in the project area, including issues related to tribal identity and land ownership and allocation, was built up from discussions and structured interviews carried out during these rounds of consultation. Moreover, specific steps were taken to access potentially vulnerable groups such as women, Bedouin, Sab'awi and gypsy groups and afford them the opportunity to engage in the study and make contributions.

There is wide variation in social context over the study area. Aqaba and Eilat are busy, developing tourist resorts centred on the weather, water, beaches and corals of the Gulf of Aqaba, with ports and industries (especially in Aqaba). The Jordanian side of the Wadi Araba/Arava Valley and Dead Sea Basin is relatively poor, and is sparsely populated with, tribal, settled Bedouin families. Herding is the main activity in the valley, with significant irrigated agriculture in the Southern Ghors. In contrast, the Israeli side of the valley has a number of wealthy agricultural communities, with extensive, high return groundwater-fed agriculture.

Table ES.9 Summary of Social Impacts and Mitigation

Potential issue/ impact	Mitigation	Eastern intake		Sea water pipeline		Dead Sea Basin		Freshwater pipeline	
		Pre mitigation	Post mitigation	Pre mitigation	Post mitigation	Pre mitigation	Post mitigation	Pre mitigation	Post mitigation
Impacts affecting communities in Jordan									
Impacts on employment and the local economy during construction	Employment/procurement policy, staff training, stakeholder engagement plan and Grievance Mechanism	●	●	●	●	O	●	O	●
Employment during Scheme operation	Employment/procurement policy, staff training, stakeholder engagement plan and Grievance Mechanism	O	O	●	●	●	●	O	O
Impacts on local marine livelihoods during construction	Stakeholder engagement plan, Construction management plan and Grievance Mechanism	●	O	O	O	O	O	O	O
Impacts of a migrant workforce on community health and wellbeing during construction	Health risk assessment, workforce management plan, Grievance mechanism	●	O	●	●	●	●	●	O
Impacts on groundwater resulting from leakage during operation	See 'hydrogeology'	O	O	●	O	O	O	O	O
Impacts of land take and changes in land use activities during construction and operation	Land acquisition and resettlement action plan, stakeholder engagement plan and Grievance Mechanism	●	O	●	●	●	O	●	●
Impacts affecting communities in Israel									
Impacts on groundwater resulting from leakage during operation	See 'hydrogeology'	O	O	●	O	O	O	O	O
Impacts of land take and changes in land	Land acquisition and resettlement action plan,	-	-	-	-	-	-	Not assessed since route not known	

Potential issue/ impact	Mitigation	Eastern intake		Sea water pipeline		Dead Sea Basin		Freshwater pipeline	
		Pre mitigation	Post mitigation	Pre mitigation	Post mitigation	Pre mitigation	Post mitigation	Pre mitigation	Post mitigation
use activities during construction and operation	stakeholder engagement plan and Grievance Mechanism								
Impacts affecting communities in the Palestinian Authority									
Impacts on employment and the local economy during construction	Employment/procurement policy, staff training, stakeholder engagement plan and Grievance Mechanism	O	O	O	O	O	O	O	●
Impacts of land take and changes in land use activities during construction and operation	Land acquisition and resettlement action plan, stakeholder engagement plan and Grievance Mechanism	-	-	-	-	-		Not assessed since route not known	

Key:

● = positive; O = slight/none; ● = moderate; ● = major

The southern Dead Sea Basin is dominated by the chemical works on both sides of the border with significant local employment. Dead Sea based tourism in Israel is centred on Ein Bokek on the southern basin, with a small but important spa at Ein Gedi, whereas Jordanian tourism is centred on the north eastern shoreline. Masada and Qumran are important tourism sites in the Basin. The freshwater route in Jordan lies along Jordan's main north-south trunk road, in a largely rural area, home to large tribes of scattered Bedouin, with some towns and villages, before entering the semi-urban outskirts of south Amman. The Jericho area suffers from water scarcity and high unemployment, with livelihoods largely focused on agriculture.

The social assessment identified that most negative impacts will occur during the construction period, and arise either from nuisance and disturbances – discussed elsewhere – or from the influx of foreign workers into a sparsely populated, conservative, poor area. There will be potential benefits from employment during construction, but the tendency of rural Jordanians to shun labour employment may limit this benefit. During operation, there will be almost no local project-specific impacts from the Scheme, since the benefits provided from the freshwater will be felt mostly outside the Scheme area. However, with appropriate mitigation measures as described in the ESMP there may be some employment opportunities in Jordan at the desalination and hydropower plants during operation which, if offered and taken up by local people, could have a substantial impact on their income and livelihoods.

A key concern from local communities that was expressed during the consultation programme is the risk to wells as a result of the leakage of seawater. However, significant safeguards have already been built into the Scheme to mitigate this (as discussed under 'hydrogeology' below).

Land acquisition and resettlement

A lands assessment was conducted that identified the amount of land area needed by the Scheme, and assessed the impacts on local communities and livelihoods. The assessment was necessarily based upon the provisional alignments and locations of infrastructure as set out in the FS. It concluded that the vast majority of the land take required will be in rural areas, most of which is not used for local livelihoods, and that almost no direct resettlement of people will be required. Nevertheless, in accordance with World Bank OP 4.12, a *Land Acquisition and Resettlement Policy Framework* has been developed (Main Report Section D6) which provides the basis for the subsequent development of a Resettlement Action Plan (RAP) during the detailed design of the Scheme when the precise component alignments, locations and hence land-takes are known. In accordance with OP 4.12, the final RAP will have specific provisions for the loss of land and assets, loss of livelihood, prior information and disclosure, and an entitlement policy and framework.

Indigenous Peoples

The ESA team also carried out an assessment of whether the ethnic groups identified in the community baseline survey should be categorised as Indigenous Peoples (IPs) according to the four-fold characterisation in World Bank OP 4.10. The assessment is presented in detail in *Annex V*. The conclusion is that, according to the OP 4.10 definitional characteristics, the people located in the project area are not identifiable as IPs. Based on this assessment, the ESA therefore recommends that the OP 4.10 safeguard should not be triggered and that separate IP plans for the Bedouin in Jordan are not prepared. The tribal people in the study area should, rather, be engaged, consulted and information disclosed to them and all other stakeholders under the umbrella of an integrated Public Consultation and Communication Plan (PCCP) and ESMP.

It should be noted that the ESMP and PCCP procedures will provide a framework under which the project owner can identify the most appropriate mechanisms to consult with different types of people (eg on the grounds of gender, age, or location), as is best practice in any ESMP. Moreover, the social assessment has identified groups of people who may be more vulnerable than others, and tailored mitigation measures accordingly. Therefore, although not being identified as meeting the definition of 'Indigenous Peoples', the ESMP ensures that characteristics that make certain sub-groups of populations more vulnerable to specific impacts will be re-evaluated and considered during detailed design and implementation of the project.

Terrestrial Ecology

The potential impacts and mitigation measures that were identified by the study relating to terrestrial ecology are summarised in *Table ES.10*, together with the likely significance of impacts before and after the proposed mitigation measures.

Potential impacts on terrestrial ecology arise mainly from the construction of RSDSC, and in particular, the disturbance or fragmentation of the fragile desert ecosystem of the Wadi Araba/Arava Valley. Key concerns included the following.

- Impacts during the construction phase associated with increased potential for disturbance of the estimated 1.2 million migratory birds that pass through the Dead Sea Basin, Wadi Araba/Arava Valley and the Gulf of Aqaba area as part of their migration route, the African-Eurasia flyway system.

- Impacts associated with increased nuisances, land take and influx of workers within close proximity to protected areas (existing and proposed) that include: Dana Biosphere Nature Reserve; Fifa Proposed Protected Area; Qatar Proposed Protected Area; other Special Conservation Areas; and Important Bird Areas.

Table ES.10 Summary of Terrestrial Ecology Impacts and Mitigation

Potential issue/impact	Mitigation	Significance (aggregated for Scheme)	
		Pre mitigation	Post mitigation
Ecological connectivity - barrier to animal movement in WAAV during pipeline construction.	Limitation of working fronts, use of earthen ramps, trench inspections etc.	🟠	O
Migratory birds – hunting, disturbance due to vehicles, noise, light, dust etc.	Site controls, further research and restrictions on activities during migration seasons etc.	🔴	🟠
Protected areas – landtake in the WAAV for the right of way and facility sites	Avoidance where possible and restrictions on access to/from sites. Habitat restoration where necessary.	🔴	🟠
Endangered/threatened species – landtake and/or disturbance	As for ecological connectivity.	🔴	🟠
Sensitive/unique habitat– landtake	Avoidance of Acacia stands, with habitat restoration where necessary.	🔴	🟠
Resident birds– disturbance	As above for migratory birds, including controls during breeding and nesting seasons.	🟠	O
Diversity and resilience of the desert habitat –physical disturbance from construction and induced development	Restricted access to/from sites, plus habitat restoration where necessary.	🟠	O
Key: 🟢 **= positive;** O **= slight/none;** 🟠 **= moderate;** 🔴 **= major**			

- The effects on ecological connectivity, especially in situations where east-west movement is limited due to construction activities or permanent structures such as the above surface pipeline or canal.

- Impacts during the construction phase on the desert crust that is the basis of the desert ecosystem characteristic of Wadi Araba/Arava Valley.

- Impacts during construction activities that involve land take and associated accesses on threatened/endangered species such as the Sand Cat that may inhabit the Wadi Araba/Arava Valley.

The impact assessment predicts that after the recommended mitigation and enhancement measures have been effectively implemented, no major negative impacts on the terrestrial ecology will be caused by construction and operation of RSDSC. There will be moderate impacts arising mainly from the construction of the seawater conveyance, these can be minimised by control of the construction phase, in particular, by minimising the amount of land that is disturbed an any one time; and by control of the movements of vehicles, management of workers' accommodation and activities. Variants of the Scheme such as the tunnel conveyance option, or the phased construction option, pose a significantly greater risk either because they disturb more valuable areas (the tunnel) or entail repeated disturbances (the phased option).

Hydrogeology

The potential impacts and mitigation measures relating to hydrogeology identified by the study are summarised in *Table ES.11*, together with the likely significance of impacts before and after the proposed mitigation measures.

Table ES.11 Summary of Hydrogeological Impacts and Mitigation

Potential issue/impact	Mitigation	Significance	
		Pre mitigation	Post mitigation
Construction Activities - temporary lowering of the groundwater table or pollution by disposal of wastewater	Good environmental management of construction, and licensing of any proposed abstractions.	🟠	O
Insidious leakage from sea water conveyance leading to contamination of aquifers	In addition to existing Scheme design safeguards, further hydrogeological research and monitoring to identify need for additional mitigation (eg isolation of sensitive zones, compensation etc).	🟠	O
Catastrophic failure of sea water conveyance leading to contamination of aquifers	In addition to above, preparation of emergency action plans and emergency response unit that may include drilling and pumping of temporary 'curtain' wells to isolate and remove spill.	🔴	🟠
Key: 🟢 **= positive;** O **= slight/none;** 🟠 **= moderate;** 🔴 **= major**			

The major concern identified by the assessment is the potential contamination of groundwater in the Wadi Araba/Arava Valley by leakage from the seawater pipeline. In an area of highly constrained water resources availability and cultural attachment to farming, stakeholder concern over this issue is very high, particularly amongst farmers on the western side of the valley. This concern includes the risk of major pipeline breaches, such as may be caused by catastrophic events, or insidious leaks that, it is thought, may be undetected for many years causing irreparable damage. The uppermost aquifer - the Araba Fill aquifer - is most at risk from such effects.

The assessment concluded that, in the unlikely event that the design safeguards fail and that seawater succeeds in passing the protective systems without being detected, it still has to infiltrate to a depth of on average 75 m to reach the deeper aquifer. During infiltration, the water is subject to ongoing processes of evaporation and retention by the subsoil skeleton. It may also be trapped on top of impervious layers. Once the aquifer is reached – which could take from months to years - a steady process of dilution will start, which will to a certain extent attenuate the effects of the leakage. The impact could at worst affect several wells, and would last for a long time. However the magnitude of the event and the risk of the event occurring are rated as very

low. Stakeholder concern about aquifer contamination may be vocal, but is not supported by the available data.

During construction it is possible that there will be temporary lowering of the groundwater table, or pollution by disposal of wastewater. Apart from in the Wadi Araba/Arava Valley, where contractors may seek permission to establish wells, use of sound environmental management measures will ensure that any effects are temporary and of little concern to stakeholders. Where water is abstracted, monitoring will be necessary to ensure that license conditions are met and/or there is no detrimental impact on local groundwater conditions.

Complete elimination of risk (installation of monitoring wells, addition of a tracer to the seawater and hydrogeological isolation of sensitive zones) would most likely incur costs disproportionate to the value of the resource. Instead, a good level of confidence can be obtained by monitoring existing abstraction wells before deciding upon any more comprehensive response strategy (potentially including compensation to farmers) in the unlikely event that an issue develops.

Public Health

The potential impacts and mitigation measures relating to public health identified by the study are summarised in *Table ES.12*, together with the likely significance of impacts before and after the proposed mitigation measures.

Table ES.12 Summary of Public Health Impacts and Mitigation

Potential issue/ impact	Mitigation	Significance	
		Pre mitigation	Post mitigation
Risk of HIV/AIDS	Ensure that all foreign workers undertake required HIV test for work permits. Incorporate HIV/AIDS management planning in contractor controls.	O	O
Risk of introduction of communicable diseases (eg Tuberculosis)	Good practice management of worker employment, health and living conditions. Ensure that all foreign workers undertake TB test. Notify local authorities in event of an outbreak.	O	O
Health and water issues	Good practice management of worker employment, health and living conditions.	●	●
Health impacts of construction activities (traffic)	Incorporiate effective traffic management planning into contractor controls.	●	O

Key:

● = positive; O = slight/none; ● = moderate; ● = major

Potential impacts on the health of the public arise primarily from the influx and movements of large numbers of workers from foreign countries who may bring communicable diseases and, due to the circumstances of their employment and living conditions, may engage in the types of risky behaviour known to spread diseases such as HIV/AIDS. It is also possible that an influx of workers may put additional strain on limited medical facilities available within the Scheme area. In addition, the construction phase will involve generation of dust and vehicle exhaust (associated with respiratory disease), and the potential for traffic accidents.

Potential impacts are mainly in Jordan (activities in the PA and Israel are much smaller-scale and will probably utilise locally recruited workers). Jordan already has effective controls and, when good practice controls on construction are implemented, the overall health risks are slight.

Nuisances and Disturbances

Table ES.13 summarises the potential significance of noise, dust, traffic and waste related impacts of the Scheme as identified by the study, both before and after the specific mitigation measures that are recommended by this assessment.

The components of the RSDSC will, for the most part, be located in uninhabited and used areas, far away from the nearest communities. During operation of the Scheme in particular there is little potential for disturbance to any community. The ESA has focused, therefore, on the key nuisances and disturbances that are likely to arise from the Scheme during construction. The issue of operational noise from pumping and desalination are also addressed since they were raised as a concern during stakeholder consultation. Potential impacts relating to air quality (dust), noise, traffic and waste were examined separately and the impacts resulting from the inter-relationship between all of these issues was then assessed. The only major potential impacts arise from construction noise where the alignment is close to inhabited areas. These and other potential impacts are readily abated by good construction practices.

Major Hazards

Table ES.14 summarises the potential significance of major environmental hazards associated with the Scheme as identified by the study, both before and after the specific mitigation measures that are recommended by this assessment.

The risk of sea water transport along the RSDSC is considered to be high for certain failure mechanisms. The consequences of a major failure along the sea water pipeline system, ie a rupture event, are deemed to be significant and it is assumed that the effects of a rupture would cause long term damage affecting an extensive area. The failure mechanism judged to give the highest levels of risk (within the high risk bracket) is "*intentional external impact*", essentially sabotage. This risk can be significantly reduced by installation of

shock-resistant composite materials above the pipeline and vibration detection, with guards patrolling the area. It is not clear that the value of groundwater resource is sufficient to warrant such costly measures and further study at the detailed design stage, including hydrogeological damage assessment, is recommended.

Table ES.13 Summary of Nuisance and Disturbance Related Impacts and Mitigation

Impact	Mitigation	Significance	
		Pre mitigation	Post mitigation
Aqaba/Eilat Urban and Coastal Area			
Noise disturbance	Good environmental management of construction.	O/🟠	O
Dust nuisance	Good environmental management of construction.	O	O
Traffic Management	Implementation of Traffic Control Plan	🟠	O
Waste management	Good environmental management of construction and provision of new landfill to serve area	🟠	🟢
Wadi Araba/Arava Valley			
Noise disturbance	Good environmental management of construction.	O/🔴	O/🟠
Dust nuisance	Good environmental management of construction.	O	O
Traffic Management	Implementation of Traffic Control Plan	O	O
Waste management	Good environmental management of construction and provision of new landfill to serve area.	🟠	🟢
Freshwater Pipeline			
Noise disturbance	Good environmental management of construction.	O/🔴	O/🟠
Dust nuisance	Good environmental management of construction.	O/🟠	O
Traffic Management	Implementation of Traffic Control Plan	O	O
Waste management	Good environmental management of construction.	O	O
Dead Sea Surrounds			
Noise disturbance	Good environmental management of construction.	O/🟠	O
Dust nuisance	Good environmental management of construction.	O	O
Traffic Management	Implementation of Traffic Control Plan	O	O
Waste management	Good environmental management of construction.	O	O

Key:

🟢 **= positive;** O **= slight/none;** 🟠 **= moderate;** 🔴 **= major**

The second highest potential failure mechanism is attributed to 'natural hazards', essentially ground movement associated with earthquakes, particularly at points where the conveyance crosses seismic faults. The risk from such failures can be significantly reduced through modern pipeline design, such as those presented in the DS Draft Sub-Studies Report (December

2010). If the project moves on to the next phase, it is recommended that the risk of failure at the seismic faults is investigated in greater detail, such that appropriate seismic fault crossing design can be established and modelled.

Table ES.14 Summary of Major Environmental Hazards

Impact	Mitigation	Significance	
		Pre mitigation	Post mitigation
Intentional external impact	Further study at detailed design stage including hydrogeological damage assessment. If required, placement of a grid system of a resistant composite material above the pipeline and vibration detection	🔴	O
Natural hazards (principally ground movement due to earthquakes)	Appropriate seismic fault crossing design	🔴	O
Mechanical defects (includes pipeline manufacture, weld failures, poor external coating and internal lining (relevant to corrosion), poor pipeline joints	Employment of appropriate international quality systems (such as ISO 9001) during pipeline design and construction.	🟠	O
Accidental external impact	Marker posts along the RoW, and at road and rail crossings; concrete slabbing above the pipeline at road crossings; marker tape above the pipeline, control of landuse in the RoW	🟠	O
Operational failure	Good operational controls, training of personnel in proactive and reactive operations, particularly if the operational parameters are exceeded, such as water pressure	🟠	O
Corrosion (external, internal and stress corrosion cracking)	External coating and cathodic protection, an internal lining	🟠	O
Risk from Chlorine Storage	Use of a less hazardous material for control of biofouling, such as hypochlorite	🟠	O
Key: 🟢 **= positive;** O **= slight/none;** 🟠 **= moderate;** 🔴 **= major**			

With regard to all other failure mechanisms, it is judged that the risk can be reduced to levels that may be in the 'medium risk' bracket, where the risk is considered tolerable if reduced to a level that is as low as reasonably practicable (ALARP) by the use of best practices, such as those outlined here. The risk from the potable water conveyance system is considered minimal. There would be a higher risk of illegal connections being made to the system in this section, but the consequences of such failure modes are not high.

If chlorine is used to control biofouling at the intake pumping station, this may present some significant risks to people in the local area because of the volume of gas required. If an alternative (inherently safe) means to control

biofouling, is used (as currently outlined in the FS Draft Sub-studies Report) this would significantly reduce these risks.

Assessment of Alternative Configurations

The differential impacts of the various component and siting variants considered during the Feasibility Study were independently examined by the ESA team. These included two options for the location of the sea water intake; three sea water conveyance types (pipeline, low level tunnel, high level tunnel; three desalination plant sites; two brine/sea water discharge alignments; and, three freshwater conveyance routes.

An independent study of overall scheme alternatives (The Study of Alternatives) is also available in preliminary draft. The main results of the SoA will be summarised in the next version of the ESA report after public stakeholder consultations in late 2012 , and the report itself will be appended.

In choosing amongst the realistic options (which had already been screened for major environmental effects at the Options Screening stage) and determining their preferred configuration, the Feasibility Study Team gave priority to issues of cost and engineering feasibility. The ESA looked at the comparative environmental and social effects of the options to determine whether there were any potential effects that were of sufficient magnitude to warrant revisiting this choice.

The results of this comparative analysis are summarised in *Table ES.15*. Differential impacts arise mainly from the different characteristics of the sites and the physical footprint of the scheme, in which regard the sea water conveyance options are most dissimilar.

In summary, moving along the Scheme configuration from south to north, at the Red Sea it was found (including by the Red Sea Modelling Study) that the Northern Intake option was inferior to the Eastern Intake in most regards as shown in the table. Along the Wadi Araba/Arava Valley (WAAV), the tunnel options were generally inferior to the seawater pipeline, largely because the worksites around the tunnel portals would be located in more sensitive areas than those of the pipeline, which passes up the arid centre of the WAAV. The low level tunnel would, however, pose less risk of groundwater salination, since leakage would likely pass beneath the freshwater aquifers, although the issue of disposal of radioactive spoil associated with the tunnels has not been sufficiently determined to include in this assessment. At the northern end of the WAAV, the low level desalination plant option was considered to be significantly inferior in ecological terms because of the close proximity and potential overlap with the newly established Fifa Protected Area (FPA). Similarly, the restitution canal alignments that pass to the east of the evaporation ponds and close to the FPA also present a more significant ecological risk, in addition to which the potential water quality impacts from a conveyance breach are more significant owing to the close proximity of densely cultivated areas.

Table ES.15 Relative Impacts of Alternative Configurations (to Recommended Scheme)

Scheme component	Variant to 'Recommended Scheme'	Dead Sea	Red Sea	Hydrology	Archaeology	Social	Visual and Landscape	Ecology	Hydrogeology	Nuisance and Disturbance
Intake Location	Northern Intake (Aqaba north shore close to Israeli border).	O	O	🔴	🔴	O	🔴	🔴	O	🔴
Seawater Conveyance Type and Alignment	Low Level Tunnel	O	O	O	🔴	O	🟢	🔴	🟢	O
	High Level Tunnel, with canal sections	O	O	🔴	🔴	O	🔴	🔴	O	O
Desalination Plant Site	Low Level Site at Ghor Fifa	O	O	O	O	O	O	🔴	O	O
	High Level Site (for Tunnel)	O	O	O	O	O	O	O	O	O
Restitution Canal Alignment	Alignments 1/2 to east of evaporation ponds	O	O	🔴	O	O	O	🔴	🔴	🔴
Freshwater Conveyance Route	Alignment 2, north of Mu'tah	O	O	O	O	O	O	O	O	O
	Alignment 3, closer to south Taflia	O	O	O	O	O	O	O	O	O

Key: 🟢 = Significantly preferable; 🔴 = Significantly inferior; O = No significant difference

ENVIROMENTAL AND SOCIAL MANAGEMENT PLAN

The ESMP constitutes a critical link between the management and mitigation measures specified in the report and the proper implementation and management of the measures during the construction and operation of the project. It summarises the anticipated environmental and social impacts and provides details on the measures, responsibilities and scheduling to mitigate these impacts; the costs of mitigation; and the ways in which implementation and effectiveness of the measures will be monitored and supervised.

In many areas, the project will have positive impacts on the quality of peoples' lives. Consistent with the scope of the project and the available resources, measures have been proposed that maximize these benefits. The RSDSC is basically an environmental improvement project. From first planning its design has incorporated a significant number of measures directed specifically towards environmental protection and the minimization and/or mitigation of potential environmental impacts. However, there is still potential for some negative impacts due to the nature of project sites or the risk that design

features will not be implemented. These have generally been addressed in three ways, as follows:

1. Additional prevention or abatement measures have been incorporated into the design of the facilities or into the specifications of equipment;

2. Operating and management procedures will be enforced that specify how staff will carry out their duties at project sites; and

3. Capacity development and administrative measures have been developed to ensure the responsible institutions have the legal, administrative and human resources necessary to fulfill their functions.

The measures required by the ESMP will be incorporated in a series of documents that will be linked through the ESMP and the associated Monitoring Plans. These documents are as follows.

- Relevant provisions of the ESMP will be incorporated into the Contract Documents prepared for firms bidding to work on major project construction activities forming a binding contractual obligation that specifies not just design features but, where the ESMP so requires, green public procurement mechanisms, management of workers, vehicles, machinery, operating times, methods of working, complaints management, etc.

- Relevant provisions of the ESMP will also be incorporated into the operational contracts. These binding contractual obligations will specify, where the ESMP so requires, site management and maintenance routines, employment practices, vehicle routes, operating times, methods of working, complaints management, etc.

- Relevant provisions of the ESMP will also be incorporated into the agreement of the entity created to manage the project. This will include: a monitoring plan for noise, dust, and water and a supervision plan to check the progress and effectiveness of the environmental and social mitigation measures; arrangements to implement the provisions of the land acquisition and resettlement policies; and provisions to implement a training program in environmental management, for national and local government officials.

The ESMP allocates responsibility for the various mitigation and management activities to several specific parties. These allocations are tentative. Decisions need to be taken at both political and technical levels during the detailed design process before the institutional framework can be more clearly defined. For the purposes of the ESMP, the following assumptions have been made.

- There will be some form of Government-led body which will steer the planning and implementation of the Scheme. This could take one of many

forms but will act as a representative agent of the Beneficiary Parties. This body will effectively act as the 'client' for the Scheme. It could be a tri-party Governance Committee, possibly with representation from international bodies, funders and donors. In the ESMP, this body is named *Project Owner*, although this does not imply that this body necessarily owns the assets of the Scheme. This role is currently fulfilled by the Technical Steering Committee.

- An entity will be established to take responsibility for the development, design, construction and operation of the infrastructure. This could to be a form of Special Purpose Vehicle (SPV), which would then delegate responsibility to a number of other entities, eg for design, construction, and operation of the various Scheme components. There are many forms which this entity could take, with a range of public – private sector involvement. This entity will have overall responsibility to manage the discharge to the Dead Sea, to supply the freshwater system, and to collect revenue. It will operate under agreement to the Project Owner. In the ESMP, this entity is named *Service Provider*.

- In the ESMP, it is useful to differentiate between the responsibilities of the Service Provider for design, construction and operation. The *Contractor* is one or several companies who will undertake to construction the Scheme. The Contractor(s) will report to the Service Provider and will take responsibility for all suppliers and sub-contractors. The *Operator* is the one or several companies who will undertake to operate the various elements of the Scheme.

- There are several scenarios for how the Beneficiary Parties may coordinate the statutory regulation of the Scheme. The Parties could create a tripartite regulator with legal standing, or could adopt a looser cooperative approach, with regulatory sovereignty retained by each Beneficiary Party, or something in between. It is likely that the regulator will evolve gradually over time, as the Scheme develops. For the purposes of the ESMP, the body (or bodies) which provide the regulatory function is termed the *Regulator*. Whatever form this takes, its responsibility will be to ensure the quality of the service, quality of the water, environmental and social protection, etc.

For the purposes of the ESMP, it is assumed that the next steps for the Scheme are as follows.

- *Pre-Construction* **–** the period possibly involving additional studies, negotiations between the Beneficiary Parties, consultations with donors and financiers, etc, taking a 'go/no-go decision' to go ahead with the Scheme, fund-raising, procurement of final design and supervision services, additional survey and studies needed for the detailed design and selection of the final alignments and locations of infrastructure, land purchase, set up of the legal and governance framework, consultation with

civil society and technical stakeholders and local communities, and land acquisition.

- *Project Construction* – the period during which construction of the Scheme will occur.

- *Project Operation* – the period following the commissioning of the completed Scheme, when water is discharged to the Dead Sea, and desalinated water is delivered to the appointed demand centres.

If a phased implementation is selected, there will be several phases of construction overlapping with operations.

Plan for Pre-Construction Activities

Table ES.17 lists some important measures identified as needing to occur in the Pre-Construction period.

Plan for Control of Construction Activities

The Plan for Control of Construction Activities sets out the sources of environmental and social impact likely to arise as a result of the construction of the Scheme. It also contains general and specific requirements or guidelines to minimize the negative social and environmental impacts from the construction operations. It includes a monitoring aspect whereby every main contractor and sub-contractor has their performance monitored.

The Plan is designed as a provisional document, to be revised and updated in conjunction with the detailed design of the Scheme. The requirement to implement the Plan, and meet the standards therein, will be made a contractual obligation on all contractors.

The Plan addresses general construction issues and controls, and acts as an umbrella management plan to cover all construction activities and contracts. The Plan covers, *inter alia*:

- workforce and local residents' health and safety;
- siting of temporary structures/work locations/materials sourcing (eg for sand dredging);
- timing of certain activities (eg to avoid the rainy season, or the breeding seasons or migratory movements of animals);
- 'good housekeeping' site management practices (eg erosion control, materials storage, maintenance of silt traps and oil separators, waste management, etc);
- surface water flow regimes during construction;
- management of camps and workers;
- management of work sites, site accesses and construction vehicles;
- water supply and wastewater disposal;
- criteria for disposal of excavated material (preliminary identification of potential sites);

- emergency response to significant accidents/pollution incidents;
- site clean-up and restoration of all areas temporarily affected by construction activities, and decommissioning of all construction-related facilities; and
- public communications and complaints management.

This Plan includes a set of General Requirements for Construction Activities, together with several other specific Management Plans, developed to deal with specific components of the construction programme or particularly sensitive receptors. They include the following:

- Land Acquisition Plan;
- Involuntary Resettlement Management Plan;
- Archaeological and Cultural Resources Management Plan;
- Construction Spoils Management Plan;
- Erosion and Sediment Control Management Plan;
- Fugitive Dust Control Management Plan;
- Noise Control Management Plan;
- Wadi Crossings Management Plan;
- Tree Planting and Habitat Restoration Management Plan;
- Traffic Control and Public Communications Management Plan;
- Occupational Health and Safety Management Plan;
- Health/HIV/AIDS Management Plan; and
- Public Consultations and Communications Plan for Construction.

The Plan also refers to a set of Constraint Maps (maps depicting the key sensitive environmental and social receptors along the alignment) that will be provided to contractors.

The level of effort applied to designing construction mitigation reflects both the scale of the Scheme and the social and ecological sensitivity of the area in which it will be constructed. These management plans recognize the possible effects of the six-year, multi-site, multi-activity construction programme, and the need to reduce the effects of the programme to levels acceptable to the stakeholders and the Beneficiary Parties.

Table ES.17 Recommended Pre-Construction Activities

Issue	Mitigating/Monitoring Activity	Indicators	Responsibility	Timing
Lack of data on risk to water quality, economic usage and heritage value of Dead Sea	Comprehensive Monitoring Programme for Dead Sea (described more fully in the ESMP)	Existence of monitoring contract, field data and reports	Project Owner to commission	To commence immediately following submission of DSMS Report
	Development and Verification of Dead Sea Model	Existence of 3D model verified against field data	Project Owner to commission	To commence immediately following submission of DSMS Report
	Implement a Pilot Project or Phased Approach	TSC/Project Owner decision, recorded in TSC minutes	Project Owner	Immediately following submission of Feasibility Study
Lack of data on risk to wells from sea water leakage	Commission hydrogeological study of Wadi Araba/Arava Valley Review results of hydrogeological study in Wadi Araba/Arava Valley and implement additional measures to protect groundwater at sensitive areas, where necessary	Existence of monitoring contract, field data and reports	Project Owner to commission	To commence immediately following submission of Feasibility Study Report
Lack of data on ecological components in the Wadi Araba/Arava Valley and their behaviour	Commission ecological studies in Wadi Araba/Arava Valley including: • joint research on east-west crossings • research on feeding and roosting behaviour of birds • research at Qatar mudflats • research at Fifa forest	Existence of monitoring contract(s), field data and reports	Project Owner to commission	To commence immediately following submission of Feasibility Study Report
Impacts of intake and pumping on marine environment	Implement design recommendations for intake			
Impacts of pipeline construction on social, cultural and ecological context	Revise the pipeline alignment and avoidance of villages, built up areas, significant archaeological sites, and significant ecological areas including Ghweiba, Qatraneh, areas of dense acacia stands, Fifa forest			

Capacity Building Recommendations

Five specific, targeted capacity building interventions have been defined as follows:

- *Activity 1.* Assistance in the creation of a Dead Sea Basin Regulatory Body;

- *Activity 2.* Assistance in the procurement of an Environmental Management Advisor (EMA) to the Technical Steering Committee/Project Owner;

- *Activity 3.* Assistance to the Department of Antiquities in Jordan on development of procedures for decision-making and rapid assessment of sites uncovered during excavations, and in outsourcing of construction monitoring survey teams;

- *Activity 4.* Assistance to the Ministry of Environment (Jordan) for the establishment of a Scheme Construction Monitoring Unit; and

- *Activity 5.* Up to date needs assessment of Palestinian Authority capability for ESMP Implementation.

Plan for Operation of the Scheme

The operation of the Scheme will be a major, ongoing intervention, with the continuous pumping of 2,000 MCM/year of seawater over a distance of over 190 km, and the pumping of up to 850 MCM of potable water over a distance of more than 200 km. The DSP will be the largest in the world, and the power generation needs will be equivalent to around 44% of the national demand of Jordan.

There are several areas where the impacts on the social and environmental fabric will not be known with certainty until the operation commences. These include:

- impacts on the marine environment in the Red Sea;
- impacts on the water quality and perception of the Dead Sea; and
- leakage of seawater from the Scheme.

For these reasons, the ongoing monitoring of the Scheme and its effects is an important component of the Scheme implementation.

The Plan for Operational Mitigation and Monitoring sets out the activities, procedures and monitoring arrangements which are required to ensure that the effects of the Scheme are understood and managed adequately. It includes six specific Management Plans which recommend a series of specific activities, with estimated costs. These are:

1. Marine and Coastal Zone Management Plan;

2. Wadi Araba/Araba Valley Ecology Management Plan;
3. Dead Sea Management Plan;
4. Habitat Restoration Programme;
5. Dead Sea Environment and Social Management Plan; and
6. Groundwater Protection Management Plan.

This Plan will need to be revised and finalized following detailed design of the final RSDSC Scheme.

Summary of ESMP Actions and Estimated Costs

Table ES.18 summarises the actions recommended in the ESMP, together with their costs, and the phase in which they should be implemented.

Table ES.18 Recommended ESMP Actions and Costs

Activity	Responsibility	Cost Est (USD)	Phase
Environmental and Social Management Plan for Pre-Construction Activities			
Comprehensive Monitoring Programme for Dead Sea	Project Owner/TSC	5 M	I
Development and Verification of Dead Sea Model	Project Owner/TSC	2 M	I
Implement a Pilot Project or Phased Approach	Project Owner/TSC	Feasibility Study	I
Hydrogeological study of Wadi Araba/Arava Valley	Project Owner/TSC	3 M	I
Additional measures to protect groundwater to be included in detailed design	Project Owner/TSC	TBD during detailed design	P
Ecological studies in Wadi Araba/Arava Valley	Project Owner/TSC	2 M	I
Implement design recommendations for intake	Project Owner	TBD during detailed design	P
Revise the pipeline alignment in detailed design	Project Owner	TBD during detailed design	P
Archaeological and Cultural Resources Management Plan (Construction)			
Walkover archaeological survey of final alignments	Project Owner	100k	P
Revise the design to avoid Category 4 sites and Category 3 sites	Project Owner	Included in design fees	P
Excavate all Category 3 sites which cannot be avoided.	Project Owner	Estimate 10k per site.	C
Take steps to protect sites lying close to the Scheme, including;	Project Owner	Included in contract price.	C
Construction controls to prevent damage to archaeological sites	Project Owner	Included in contract price	C
Implement Chance Finds Procedures – see below	Project Owner	Included in contract price	C
ESMP for Marine and Coastal Zone during Construction			
Construction controls to protect marine environment – general	Contractor	Included in contract price	C

Activity	Responsibility	Cost Est (USD)	Phase
Construction controls to protect marine environment - specific	Contractor	Included in contract price	C
Working procedures for marine plant	Contractor	Included in contract price	C
Prohibit anchoring over coral reef	Contractor	Included in contract price	C
Implement Red Sea Monitoring Programme (Construction)	Project Owner	200 k annually,	C
ESMP for Wadi Araba/Arava Valley during Operation			
Attach 2 experienced ecologists to the EIU for the entire pipeline construction period,	Project Owner	600 k over 4 years	C
EIU communication protocols - construction	Contractor	Included in contract price	C
Tree Planting and Restoration of Natural Habitats Plan			
Site restoration actions	Contractor,	Included in contract price	C
Environmental and Social Management Plan for Marine and Coastal Zone during Operation			
Red Sea Monitoring Programme	Project Owner,	200k annually – to be revised	I
Environmental and Social Management Plan for Wadi Araba/Arava Valley – Operation			
EIU communication protocols - operation	Operator to establish	Included in operation costs	O
Environmental and Social Management Plan for Dead Sea			
Implement Dead Sea Monitoring Programme – see below.	Project Owner	300 k USD annually	I,P,C,O
Messaging strategy Scheme – see PCCP.	Project Owner	Included in PCCP	I,P,C,O
Zero discharge protocol for operation	Operator	Included in operation costs	P
River Jordan nutrient reduction programme	Beneficiary Parties	3 M	P
Remedial actions at Dead Sea Hotels and Spas	3rd parties – hotels and spa facilities,	TBD during detailed design	P
Dead Sea monitoring and communication with chemical industries	Project Owner and Operator	None	C,O
Groundwater Monitoring Plan			
Groundwater Monitoring Programme	Operator	Included in operation cost	I,P,C,O
Emergency Response Plan	Operator	Included in operation cost	I,P,C,O
Capacity Building Activities			
Assistance in the creation of a regulatory body for the Dead Sea	Project Owner/TSC	4.5 M	I,P
Provision of ESMP Monitoring Advisor (EMA) to Project Owner	Project Owner/TSC	4.9 M	I,P,C,O
Assistance to Department of Antiquities (Jordan)	Project Owner	1.1 M	P,C
Assistance to Ministry of Environment for Scheme Construction Monitoring Unit	Project Owner	3 M	P,C
Needs Assessment of Palestinian Authority capacity for ESMP implementation	Project Owner	0.3 M for study	P,C

Activity	Responsibility	Cost Est (USD)	Phase
Health and HIV Management Plan			
Ensure implementation of commitment to maximise local employment	Project Owner	Included in contract price	C
Provide daily transport to site	Contractor	Included in contract price	C
Health checks for workers	Project Owner	Included in contract price	C
HIV testing for all employees	Contractor and Project Owner	Included in contract price	C
Worker education and training on HIV/AIDS.	Contractor	Included in contract price	C
Closed construction camps – strictly enforced.	Contractor	Included in contract price	C
Code of Conduct for workers	Contractor	Included in contract price	C
Health Risk Assessment:	Contractor	Included in contract price	C
Provision of health care on construction camps	Contractor	Included in contract price	C
Worker screening for TB	Contractor	Included in contract price	C
Ongoing consultation and stakeholder engagement	Project Owner	-	I,P,C,O

Key for phases: I = immediately, P = pre-construction, C = construction, O = operation.

Estimated costs for these items were developed and are set out in Part D of the Main Report. The total cost of these actions is 35.1 M USD. However, it should be noted that these are additional environmental and social mitigation costs, over and above the significant investments already integrated within the project design as a consequence of having carried out the Feasibility Study and ESA in close coordination. The ESMP also recommends setting aside a provisional sum of around 40 M USD for a social development fund. This brings the total additional expenditure on environmental and social mitigation measures to 75.1 M USD.

(Note that an estimate for land acquisition and resettlement costs was also made in the ESA, but this has been passed to the FS for use in their costings, and is therefore not included in this ESMP cost.)