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The Red Sea-Dead Sea Conveyance (RSDSC) Project: A Solution for Some Problems or a Cause for Many Problems?

H. S. Salem

ABSTRACT

Both of the Feasibility Study (FS) and the Environmental-Social Assessment (ESA) Study of the Red Sea-Dead Sea Conveyance (RSDSC) Project have been approved by the World Bank and thus have been undertaken in August 2008 by international companies and regional (Israeli, Jordanian, and Palestinian) sub-contractors. If the RSDSC Project would be approved after conducting both of the two-year studies, with a budget of approximately US$ 10-15 million, then the Project’s operations will start shortly after finishing both of the studies, with a preliminary budget of about US$ 5 billion. The Project is primarily aimed to elevate the Dead Sea to where it was some 30-40 years ago (around 400 m below mean sea level (MSL)). It is, as of January 2008, around 421-422 m below MSL. The Project consists of three major sub-projects: 1) Construction of the Conveyance itself, with a total length of around 180-200 km, which will transfer annually about 2 billion cubic meter (BCM) of saline water from the Red Sea to the Dead Sea. This is equal to about 5.5 million cubic meter (MCM) per day; 2) Construction of a hydropower plant that is supposed to generate annually somewhere between 550 and 860 megawatt (MW) of electricity; and 3) Construction of, at least, one desalinization plant that will be run using the electricity generated from the hydropower plant. The desalinated water (800-850 MCM/yr) will be divided amongst the Jordanians, Israelis, and Palestinians. The rest of the saline water, along with the rejected brine, will be dumped into the Dead Sea. Obviously, these goals sound great, but, on the other hand, one should strongly consider the alternatives for such a mega project, in view of the many negative impacts that will result from the RSDSC Project. These mainly include geological, seismological, hydrogeological, limnological, environmental, ecological, archaeological, climatic, economical, social, and political impacts. In this study, the above mentioned issues, along with the uniqueness and characterization of the Dead Sea and the official and unofficial reactions towards the Project, are thoroughly investigated and analyzed, and due alternatives and recommendations are presented.

Keywords: Dead Sea; Sinkholes; Red Sea-Dead Sea Conveyance (RSDSC); Positive Impacts; Negative Impacts; Alternatives; Recommendations.

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DEAD SEA

Importance

The Dead Sea (see Fig. 1) is a habitat for some unique bacteria, though its water is *‘hyper-saline’* (or *‘brine’*). The Dead Sea area is still the home of rare species, such as the leopard and ibex, as well as hundreds of bird species (WAP, 2008). The Dead Sea represents a unique ecosystem, with geological, chemical, biological, and climatic characteristics that are found nowhere else on Earth. The combination of these elements of uniqueness, along with its climate, salts and minerals, and hot springs, etc., has turned the Dead Sea into a major health resort, with particularly beneficial effects on skin diseases.

![Figure 1](image-url): Two NASA images of the Dead Sea region, showing its location, taken from space via satellite (after Extreme Science, 2008; Wikipedia, 2009a).

The Dead Sea enjoys worldwide appreciation, because of its special location and importance. It is presently running for the status of a ‘World Heritage Site’. The areas around the Dead Sea and Wadi Araba are of outstanding, distinguished historical and archeological importance, such as Ein Gedi, Mas’ada and Bab edh-Dhra, as well as other numerous smaller sites on the Dead Sea’s eastern and western shores. Theologically, the
biblical story of ‘Sodom and Gomorrah’ was situated on the eastern side of the Dead Sea, as an etiological saga, explaining the origins of the salty sea, its salt-crusted coast, and rock-salt formations. According to some geologists, ‘Lot’s wife’ has been identified alternately in the numerous salt pillars that can be found on the southern coast (Reuters, 1995).

The Dead Sea’s economic importance mainly stems from two components on both sides of its shorelines, which are:
1) Tourism and health tourism, supported by a year-round hot weather, an enriched oxygen atmosphere, therapeutic UVB (Ultra Violet) solar radiation, a mineral-rich salt sea, world famous mineral-rich mud, and thermo-mineral hot springs. Research has shown that the combined climatic factors have a long lasting positive therapeutic effect on dermatological diseases, such as ‘psoriasis’, ‘eczema’, and ‘rheumatic or degenerative joint diseases’ (AAGT, 2009).

2) Extensive potash industry at the southern part of the Dead Sea (now isolated basin) (see Fig. (1) and Fig. (3)). Both industries (tourism and potash) contribute considerably to the economy of Jordan and Israel; however not to the Palestinian economy, as Palestinian access to the Dead Sea is severely impeded by Israel’s military occupation.

Characterization

The Dead Sea gets its water from several sources, mainly the Jordan River and its tributaries (such as the Yarmouk, Hasbani, Dan and Banias) and from wadis (such as the Zerqa, Mujib, Kerak, and Hasa) (see Fig. 2). The Dead Sea has a catchment area of 41,650 km², maximum depth of 378 m, average depth of 147 m, maximum length of 76 km, maximum width of 18 km, water salinity (total dissolved solids (TDS)) of 33.7% (about 340 g/l), and water density of 1.24 kg/l (Gavrieli and Bein, 2005; Ashbel and Brooks, 2007; New World Encyclopedia, 2008; Wikipedia, 2009a). The water level (surface elevation) of the Dead Sea is 421-422 m below the mean sea level (MSL) (Wikipedia, 2009a; Abu Ghazleh et al., 2009). These characteristics have made the Dead Sea the lowest point and deepest hyper-saline lake on Earth.
The average temperature of the Dead Sea area is about 40 °C in summer and about 15 °C in winter (EXACT, 1998). The annual rainfall over the Dead Sea area is around 90 mm, meanwhile the annual evaporation rate is 1,500 mm, with an actual evaporation rate of 1,300-1,600 mm/yr, (UNEP, 2008), depending on the salinity and temperature variations at the surface of the Dead Sea, which both are affected by the annual volume of freshwater inflow. These evaporation rates indicate that an average deficit of about 1,400 mm of the Dead Sea water occurs every year.

**Sea Level Decline**

Over the last 50 to 60 years or so, the Dead Sea has been severely disturbed to a degree that it has become an unbalanced ecosystem. The great damage to the Dead Sea is a direct result of the anthropogenic (man-made) interventions.

The huge demand for water in Israel and Jordan, in particular, has put a huge strain on the Jordan River, which has led to a much less water flowing into the Dead Sea than what used to be. What does still flow into the Dead Sea is mainly domestic and industrial sewage. The Lower Jordan River, which used to discharge in the Dead Sea 1.2-1.3 BCM/yr, discharged around 450 MCM/yr some ten years ago, and around 250 MCM/yr of bad quality water some 5 years ago (Salameh and El-Naser, 1999; DSP, 2004). Also, artificial evaporation ponds (see Fig. (3)) have been created to extract the valuable minerals from the Dead Sea water. As a result, the level of the Dead Sea has dropped in the last 30 years or so by almost one meter per year, and this drop is accelerating at alarming rate.

However, it is unlikely that the Dead Sea will dry up completely, but its surface area will diminish to an estimated 300 km², which is approximately 1/3 of the ca 940 km², as was measured in 1966 (McCulloch, 2006; WAP, 2008). Simulations based on water withdrawal scenarios suggest that the Dead Sea will not completely disappear; rather, a new equilibrium is likely to be reached in about 400 years after a water-level decrease of 100-150 m (Yechieli et al., 1998). This suggests that, after about 400 years from now, the water level in the Dead Sea will reach roughly 520-570 m below MSL, taking into account the present water level of 422 m below MSL.
Figure 2: Major wadis and their annual discharge (in MCM/yr, given in red) into the Dead Sea (after GLOWA, 2005).

The surface area of the Dead Sea is known to have varied from 1,440 km² at its historical high of about 330 m below MSL to about 625 km² at 416 m below MSL (Gavrieli et al., 2005; Exact, 2005). The average annual water deficit of the Dead Sea was, in 2005, approximately 600-625 MCM/yr, considering an annual sea level drop of 1 m/yr and a surface area of 625 km² at an elevation of 416 m below MSL (Gavrieli et al., 2005; Gavrieli and Bein, 2005). Using a GIS (Geographic Information Systems) modeling technique, Abu Ghazleh et al. (2009) indicated that the Dead Sea shrinks, on average, by 4 km²/yr in surface area and 470 MCM/yr in volume, amounting to about 14 BCM/yr for the last 30 years alone.
Table 1: Observed and projected variations of the mean sea level (MSL) and surface area of the Dead Sea over a period of 90 years (1960-2050) as seen in Fig. (4) (after Lipchin, 2009).

<table>
<thead>
<tr>
<th>Year</th>
<th>Figure</th>
<th>MSL (m)</th>
<th>Surface Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>4-A</td>
<td>-390</td>
<td>1,020</td>
</tr>
<tr>
<td>2005</td>
<td>4-B</td>
<td>-420</td>
<td>635</td>
</tr>
<tr>
<td>2050</td>
<td>4-C</td>
<td>-500</td>
<td>520</td>
</tr>
</tbody>
</table>

Table (1) indicates that within 90 years only (1960-2050), the water level of the Dead Sea has and will be declined by about 110 m (this is equivalent to more than 1.2 m/yr in average), and its surface area has and will be shrunk by about 500 km² (this is, in average, 5.5 km²/yr). This average is a little bit higher than the average (4 km²/yr, see above) given by Abu Ghazleh et al. (2009), because, in Lipchin (2009), the projected variations until 2050 are taken into consideration.

A part of the Dead Sea water level’s decline is attributed to the high evaporation rates, amounting to about 25-30% of the Dead Sea brine in the evaporation ponds (see Fig. (3)) of the Israeli and Jordanian mineral (mainly potash) industries, located in the southern basin of the Dead Sea (UNEP, 2008). These industries pump together 400-450 MCM/yr from the Dead Sea into the evaporation ponds (Gavrieli et al., 2005).

The rest of the Dead Sea water level decline (about 70-75%, representing a huge drop) is attributed to the Israeli, Jordanian and Syrian diversions of the Jordan River waters and its tributaries, and to the Israeli pumping of huge amounts of water from the Tiberias (Tabariyya) Lake (Sea of Galilee) (see Fig. (1), left). For example, Israel alone, since the 1950s, has been annually diverting from the Jordan River and its tributaries and pumping from the Tiberias Lake about 600 MCM of fresh water (causing a huge decline in the Tiberias Lake water level), and transferring it to the coastal cities on the Mediterranean Sea and in the Negev Desert, through the Israeli National Water Carrier (NWC, for its location, see Fig. (16)). At the same time, Israel does not allow the Palestinians to use any amount of the Tiberias Lake and Jordan River waters (Salem and Isaac, 2007). It is important to mention that the Tiberias Lake has dropped by approximately 6 m (from ca -209 to -215 m) over a period of about 19 years only (from...
Figure 3: Two NASA images of the Dead Sea’s evaporation ponds for the years 1989 and 2001, taken from space via satellite (after NASA, 2001).

Figure 4: Decline of the Dead Sea surface area (after WAP, 2008; Lipchin, 2009).
1990 to 2009), as of January 11, 2009 (Lipchin, 2009). This decline in the Tiberias Lake water level represents more than 0.3 m/yr. The Dead Sea level has exhibited considerable fluctuations over a long period of time (see Fig. (5)). This Figure demonstrates the fluctuations over a period of more than 1,000 years. The Dead Sea level, despite its steady fluctuations, has been exhibiting, since the early years of the 20th century (year 1900 and up), a highly remarkable decline at accelerating rates (see Fig. (5) and Fig. (6)). This decline is in the range of 17-117 cm/yr for the period of 1930-2008 (see Fig. (6)).

![Water level of the Dead Sea](image)

**Figure 5:** Historical water-level records of the Dead Sea for a period of more than 1,000 years, including the very large rise and fall in water level around the first century B.C. (Klein, 1965; Klein and Flohn, 1987; EXACT, 1998).

Consequences of the Dead Sea diminished surface area have already caused losses to conventional tourism in the Dead Sea area. These consequences include diminishing landscape values, drying up of natural springs, and forming of salt dust on the dried-out plains, which is carried out by winds over the region and can seriously harm fertile lands and people as well. Another important and serious consequence is the continuation of appearance of the sinkholes’ land-subsidence phenomenon (see below).
Figure 6: Dead Sea water level decline over the last 78 years (1930-2008) and sinkholes’ formation (discussed below) in the Dead Sea area during the period of 1980-2005 (after Sherman and Rybakov, 2009).

The decline in the Dead Sea water level is linked, of course, to a gradual decrease in its surface area. For a period of more than 1,000 years (see Fig. (5)), the surface area of the Dead Sea has decreased from about 1,440 km² (at its historical high of sea level of about 330 m below MSL) to about 670 km² (at about 410 m below MSL) (see Fig. (7)). This is more than 53% difference in the surface area (\(1,440 - 670 = 770 \text{ km}^2\)) and about 25% difference in the sea level (\(330 - 410 = -80 \text{ m}\)). This is linked, of course, to a corresponding difference in the volume of water lost to evaporation each year.
Sinkholes

Over the last few years, thousands of sinkholes have developed at an increasing pace, along the western and eastern shores of the Dead Sea. A recent news report of the ‘Associated Press’ stated that the number of sinkholes in the Dead Sea area has reached up to 3,000 (Marks, 2009). The number of sinkholes on the western shores of the Dead Sea has increased from almost zero to about 900 just in about 25 years (1980-2005) (see Fig. (6), upper right). This phenomenon is due to the decline in the water level of the Dead Sea, which has led to drops in the groundwater table in the surrounding area. Sinkholes form when a subterranean salt layer that once bordered the Dead Sea is dissolved by underground fresh water that follows the migration of the salt/fresh water interface, due to receding water level of the Sea. Consequently large areas of land are subsiding. The Dead Sea sinkholes are, in average, 1-10 m deep with a diameter of up to 25 m (Marks, 2009; MSNBC, 2009), and some of them are 20 m deep and 30 m in diameter (Sherman and Rybakov, 2009) (see Fig. (8)). According to Israeli geologist Eli Raz (MSNBC, 2009), “These -craters- can open up in an instant, sucking in whatever lies above and leaving the surrounding area looking like an earthquake zone”. These geomorphologic changes

Figure 7: Dead Sea water level fluctuations as related to its surface area variations over a period of more than 1,000 years (after EXACT, 1998).
represent, according to Eli Raz, “the most remarkable evidence of the brutal interference of humans in the Dead Sea.” They present a serious problem to the Dead Sea region, as they have led to damages in the surrounding infrastructure, and have threatened the human safety. Large coastal areas along the Dead Sea have already been totally closed to access and this phenomenon will further increase rapidly.

**Figure 8:** (a) Location map of the Dead Sea Basin along the Dead Sea Transform Fault (DSTF) System (discussed below); (b) Distribution of sinkhole sites along the Dead Sea western shore; and (c - below) examples of sinkholes (after Abelson et al., 2003; Sherman and Rybacov, 2009; IRIN, 2009).
WATER CONDUITS IN MIDDLE EAST

Historical Background and Recent Developments

Israeli and international politicians and visionaries (Zionists and others) have called, for over a century and a half ago (including the last 61 years, i.e., since the state of Israel was established in Historical Palestine in 1948), for a national undertaking to link the Dead Sea to either the Mediterranean Sea (Med-Dead) or the Red Sea (Red-Dead) via a canal. In 1855, admiral William Allen (English naval officer and explorer; 1792-1864) first proposed constructing a canal to link the Red Sea with the Dead Sea, as an alternative to the then-planned Suez Canal, linking the Red Sea with the Mediterranean Sea (Allen, 1855). In 1902, Theodore Herzl (Austro-Hungarian journalist and father of modern political Zionism; 1860-1904) wrote about his vision of constructing a canal linking between the Mediterranean Sea and the Dead Sea (Herzl, 1902). In 1937, Albert Hiorth (Norwegian engineer; 1876-1949) had grandiose plans for a project to bring water from the Mediterranean Sea to the Dead Sea, which could irrigate all of Palestine (see Fig. (9)). The Norwegian General Secretary of the United Nations (UN) at that time, Trygve Lie, suggested in June 1948 that Albert Hiorth’s plans were realized (Kragh, 2008).

Figure 9: Norwegian Engineer Albert Hiorth (in 1937) pointed at a map of Historical Palestine, in regard to his visionary project on transferring water (after Kragh, 2008).
During the energy crises of the early 1970s, the Israeli government began to pursue seriously the construction of the Med-Dead Canal, in order to generate hydroelectricity and to partly end the country’s dependence on oil. This was, in fact, a fulfillment of the 1902-Herzl’s vision, as it was seriously considered in the 1970s by the Mediterranean Sea – Dead Sea Company (MSDSC, 1984). In the 1980s, the Israeli government’s Science Minister, Yuval Neeman, commissioned the Med-Dead Canal Project, for which five routes were proposed, and the southern route was chosen (discussed later in some detail). The political atmosphere at that time proved too difficult and the Project was abandoned in 1984 (MedDead.org, 2008). In addition to that, financial constrains eventually halted the Med-Dead Project, as its estimated cost was too high (some US$ 2-5 billion). Jordan then opposed the Med-Dead Project, claiming that, if built, it would illegally traverse the Gaza Strip and harm the potash industry on the Jordanian shores of the Dead Sea. It was not until the ‘Peace Process’ in the early 1990s when the Red-Dead Canal evolved from a purely national Israeli project to a multilateral project, associated with Arab-Israeli cooperation.

**Multilateral Approaches**

During the last decade of the 20th century, Jordan and Israel have expressed interest in constructing a conveyance that links the Red Sea with the Dead Sea to save the Dead Sea area from further decay, and to save the Dead Sea water level from further decline. During the ‘World Summit on Sustainable Development’ (held in 2002 in Johannesburg, South Africa), Israel and Jordan jointly announced their interest in building a huge conveyance with a total length of 180-200 km, taking advantage of the difference in the water levels between the two seas. The World Bank (WB) supported the idea and, thus, adopted a plan to construct a canal linking the Red Sea with the Dead Sea. The canal is widely known as the ‘Red Sea-Dead Sea Conveyance (RSDSC)’; the name which is used in this study. In literature one can also find some other names for the Canal, such as ‘Red-Dead Conveyance’, ‘Red-Dead Conduit’, ‘Red-Dead Canal’, ‘Red-Dead Pipeline’, or some advertisement-style names, like ‘Peace Canal’ and ‘Peace Conduit’. For the locations of the RSDSC and Disi Basin in Jordan (discussed later), see Fig. (10).
At the May-2005 World Economic Forum, held on the Jordanian side of the Dead Sea, Israel, Jordan and the Palestinian National Authority (PNA), along with the World Bank (WB), announced that the beneficiary parties had agreed to launch a two-year US$ 15 million ‘Feasibility Study (FS)’ and ‘Environmental-Social Assessment (ESA)’ study for the RSDSC Project (see Fig. (11)). In August 2008, the World Bank approved both of the studies. In response to the WB’s request for donor funding, five countries originally committed themselves to part-financing of the FS and ESA studies. These are France, Greece, Japan, the Netherlands, and the USA. Later, two more countries (South Korea and Sweden) have committed themselves to make up the more donations, so that funding is complete (WAP, 2008). The FS (the primary component) looks into the technical, economic, and financial aspects of the RSDSC Project, while the ESA (the secondary component) looks into the environmental, social and archaeological aspects of the Project.

However, the misbalance between the two studies (FS and ESA), in terms of allocated cost for each (though specifically unknown), importance and priorities, already reveals that the main purpose of these two studies is not to carry out, seriously, unbiased investigations of all negative impacts and to consider alternatives to the RSDSC’s option. To the contrary, this misbalance has already created a clear momentum in favor of one option, which is the RSDSC Project. In addition, the choice of who performs the studies – a French private engineering company ‘Coyne et Bellier’ (CEB, 2009) and a British private consultancy office ‘Environmental Resources Management’ (ERM, 2009) –indicates that large scale engineering ‘solutions!’ will have a better chance to carry through. It is worrying that the same companies that would be eligible for carrying out the RSDSC Project are invited to give a neutral and unbiased assessment for the best option.

Unilateral Plans/Approaches/Actions

Just recently (end of June 2009), some news agencies reported that the RSDSC Project has been approved by the World Bank, even before the two-year FS and ESA studies come to end, as originally planned. It states that, ‘The World Bank has approved a pilot plan for a canal linking the Red Sea to the rapidly shrinking Dead Sea. Israeli public radio says the World Bank
will provide US$ 1.25 billion in finance for the Project. Mr. [Silvan] Shalom [Israeli Deputy Minister to the current Prime Minister Benyamin Netanyahu], who met the World Bank President, Robert Zoellick, in Washington on Friday [June 26, 2009], said approval from the global institution [World Bank] is a “spectacular” development aimed at relaunching the Project,” (News.com.au; Yahoo.com – June 27-28, 2009a). Ian Black (The Guardian’s Middle East Editor) reported on June 27, 2009, “Hopes of building a canal linking the Red Sea to the Dead Sea have been given a fresh boost with 11 firms commissioned to produce feasibility studies. Their work will be submitted to an Israeli-Jordanian-Palestinian committee looking at ways to implement

Figure 10: Location map of the Red Sea-Dead Sea Conveyance and Disi Basin (after IRIN, 2009).

Figure 11: Letter of Agreement of the RSDSC Project’s Terms of Reference (ToR) signed, on May 9, 2005 at the World Economic Forum – Dead Sea, by (from left) the Palestinian Minister of Planning Ghassan Al Khatib, the Jordanian Minister of Water and Irrigation Raed Abu-Soud, and the Israeli Minister of National Infrastructure Benyamin (Fouad) Ben-Eliezer (after Lipchin, 2009).
the huge engineering scheme, which could take as long as 25 years to complete,” (The Guardian, 2009a).

Jordan was quick to deny the Israeli official claim. Fayez Batayneh, Jordan’s Director for the RSDSC Project, told The Jordan Times (on July 12, 2009) that, “We read the news in the newspapers and were shocked that a major decision was taken without our knowledge. It is not clear whether it is correct or not. ... We are contacting the World Bank to check.” He added, “I hope, of course, the news report is true, because it means real progress on the project,” (The Jordan Times, 2009a).

On the Israeli side, Nitzan Horowitz, a member of the Israeli parliament and chairman of the ‘Lobby to Save the Dead Sea’, said in a statement: “We call on the government of Israel to halt actions on the Red-Dead Canal until the feasibility study is completed and all possible effects – economic, social and environmental – are examined.... We call for further examination of alternative solutions for saving the Dead Sea,” (AlertNet, 2009). In addition, ‘Friends of the Earth – Middle East’ (FoEME), which strongly opposes the Project, issued a statement claiming that these news reports show that, “Politicians are using the Red-Dead Canal Project for their own political image and not out of concern for the Dead Sea,” (GreenProphet.org, 2009a). Both Binyamin Netanyahu and Silvan Shalom (Israeli Prime Minister and his Deputy Minister) have claimed that this project is important for the advancement of the region’s ‘financial peace’ as part of the broader regional peace agenda (GreenProphet.org, 2009a).

Official and Public Reactions towards the RSDSC Project

In the early stages of the RSDSC Project, the plan to save the Dead Sea was well received by many parties. However, as time passed and plan progressed, critical sounds became more audible. The Project’s negative effects on the Dead Sea and its surrounding environs had hardly been studied. The World Bank, however, held three public hearings in Israel, Jordan, and the Palestinian Authority Territories (PAT), as part of its preliminary study into the feasibility of the RSDSC Project. As a result, the public reactions in the region were generally strong, as the majority of the public has opposed and rejected the Project.
Many of the points investigated and discussed in this study were raised by the Author and other participants in both of the public hearings held in PAT, in the presence of representatives from the World Bank (WB), the Palestinian Water Authority (PWA), and some private companies. The first hearing was held on August 9, 2007 at the Intercontinental Hotel in Jericho, and the second was held on July 29, 2008 at the Best Eastern Hotel in Ramallah. The critics received considerable support from the public attendees of both of the hearings on the points they presented and discussed with the representatives of the WB, PWA, and private companies.

Many scientists, environmentalists, and green organizations believe that trying to fix a man-made crisis, like this, by going against nature and getting even more ecological systems out of balance will have disastrous consequences. They believe that such a project is a big risk, as it will damage the beauty and attraction of the Dead Sea area and, that, in addition, the tourism industry will be harmed (The Epoch Times, 2008). On the Israeli side, for example, the World Bank came under intense fire from a coalition of six organizations: ‘Israel Union for Environmental Defense’, ‘Tzalul’, ‘Life and Environment’, ‘Friends of the Earth – Middle East (FoEME)’, ‘Society for the Protection of Nature’, and ‘Green Course’ (Doherty, 2008).

Reacting, just recently (July 9, 2009), on the Israeli policies of confiscating more Palestinian land to illegally build Jewish settlements in the West Bank, the Palestinian National Authority warned that it will withdraw from the RSDSC Project if Israel does not stop expropriating Palestinian land for its settlement activities in the Occupied Palestinian Territories (OPT). “If Israel does not halt this plan, the Palestinian National Authority will ask the World Bank to stop the two-seas project, linking the Red Sea with the Dead Sea,” said a Cabinet statement issued by the Office of the Palestinian Prime Minister, Dr. Salam Fayyad (The Jordan Times, 2009b). Commenting on the Palestinian reaction, the Jordanian Minister of State for Media Affairs and Communications, Nabil Sharif, told The Jordan Times on July 8, 2009, “We think that the [Palestinian Cabinet’s] decision aimed to make the Israeli authorities stop their plans to expropriate large tracts of land between Jerusalem and the Dead Sea,” (The Jordan Times, 2009b).

Many believe, however, that the government of Israel has worked very hard to include Jordan, in particular, in the RSDSC Project, in order to
guarantee the huge financing for the Project from international donors. Roni Milo (former Israeli Minister for Regional Cooperation) said, in this regard, “Jordan is the key to obtaining support from the World Bank. If the Pipeline [RSDSC] were situated on the Israeli side we would not be able to get this financing,” (Sharp, 2008). Erez Ron (Israeli’s Manager for the RSDSC Project) argues that the Project will further integrate Israel and Jordan economically, as he said, “We are not maximizing the potential that can be obtained from it [the 1994 Israeli-Jordanian Peace Treaty]”. He added, Look how long a border we have with them [Jordanians], and how little is happening. But the moment you create shared economic interests, they [Jordanians] will have to continue running with it... It’s a completely political project [the RSDSC Project].” (Ha’aretz, 2006; Sharp, 2008).

Shimon Peres (the current Israeli President and former Prime Minister and Defense Minister) wrote in 1993, “Politically, this earthshaking enterprise [RSDSC Project] can help maintain peace and establish mutual long-term interests. This benefits not only the nations of the Middle East but those outside the region. ... I believe it [the RSDSC Project] will be built. The water will flow along the Arava [Wadi Araba], the power stations will give light, and the wasteland will bloom with life. The region will experience peace, serenity and progress. People from other countries will use the sea port and airport, visit the spas and vacation centers, and enjoy the products of our flourishing desert,” (Peres, 1993). This means warming up the age-old Zionist tales of progress generation: ‘Desert Bloom’, ‘New Singapore’, etc., as if it was not precisely the implementation of such projects (like the Israeli National Water Carrier (NWC), built in the 1950s) that led to the disaster at the Dead Sea in the first hand1.

Yitzhak Tshuva, the Israeli real estate magnate, has answered Israel’s President Shimon Peres’ vision for a so-called ‘Peace Valley’ to be built along the RSDSC, including a corridor of shimmering skyscrapers, casinos, man-made lakes, and 200,000 hotel rooms. That is more hotel

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“Let us not, however, flatter ourselves overmuch on account of our human victories over nature. For each such victory nature takes its revenge on us. Each victory, it is true, in the first place brings about the results we expected, but in the second and third places it has quite different, unforeseen effects which only too often cancel the first.”
rooms than currently exist in all of Israel (Kraft, 2009). The vision is for a new tourist and industrial Mecca that planners hope would draw as many as three million Israelis to live in the region. The Tshuva’s project, whose scale would be unprecedented in Israel, is described as, ‘Las Vegas meets Dubai in the Arava [Arab] Desert’ (Kraft, 2009). Yitzhak Tshuva said, just recently (on July 1, 2009), that, “Accelerating the digging of a canal between the Red Sea and the Dead Sea will add a million jobs to the economy,” and that he “hopes there will be more gas reserves found, so that we [Israelis] can export [oil] as well,” (Globes Online, 2009). “With an entrepreneur [tycoon] like Tshuva entering the fray, there’s no telling how this undertaking will end up. But with a guy like Yitzhak Tshuva at the helm, Israel is sure to come out a leader,” (GreenProphet.org, 2009b).

According to Sharp (2008), “Opponents of the Canal charge that Israel and Jordan are exaggerating its political symbolism, in order to generate the US$ 5 billion dollars (or more) in international financing for what is in essence a desalinization and hydroelectric project with potentially serious environmental drawbacks.” He continues, “Moreover, there is some concern that without a Palestinian-Israeli settlement that addresses the Dead Sea borders and water rights, Israel and Jordan, which concluded Canal at the expense of the Palestinians.”

Some observers, however, believe that there is here a big issue of water allocation in the region among the Israelis and the Palestinians. Accordingly, such an issue should be addressed first and foremost before thinking about mega projects in the region, such as the RSDSC Project. For example, some peace activists claim that the RSDSC Project avoids the larger issues of managing trans-boundary water resources. “The World Bank and its sponsors have no intention of actually forcing regional actors to address their own responsibility in the water shortage, as this would present very awkward questions for the West’s regional allies. Why, for example, is the average Israeli able to consume four times as much water, per capita, as the average Palestinian?”, an observer questioning (Humphries, 2007). It is noteworthy to mention here that in some areas of the West Bank, Palestinians are surviving on as little as 10 to 15 liters a person per day, which is at or below the ‘Humanitarian Disaster Response Level (HDRL)’
recommended to avoid epidemics. In Gaza, where Palestinians rely on an aquifer that has become increasingly saline and polluted (Salem and Isaac, 2007), the situation is worse. Only 5-10% of the available water is clean enough to drink. This is according to The Guardian (2009b), commenting on the World Bank’s report (WB, 2009), in which a recent map of the water situation in the Occupied West Bank is published (see Fig. (12)).

![Map of assessment of restrictions on water sector development in the Occupied Palestinian West Bank (after World Bank (WB), 2009).](image)

Some environmentalists on the Jordanian and Israeli sides have expressed strong opposition to the RSDSC Project. They claim that the RSDSC Project is driven by the Israeli and Jordanian construction companies’ interest in such a mega project. Sufian Tal from Jordan – United Nations’
Environmental Programme (UNEP)’ expert on water and environment - argues that the RSDSC Project is not feasible and will have a profound impact on the environment. He said, “What is being said about the Red-Dead Canal meeting our needs without negative consequences is fiction.” He added, “We can design the Disi project pipeline to pump water from the Red Sea as well as the Disi [Basin] area,” (Zawya.com, 2009). The ‘Disi Water Conveyance Project’ (DWCP) is a pipeline to pump about 100 MCM/yr of fresh ‘fossil’ water from the Disi Aquifer System (DAS), also known as Disi Basin, in southern Jordan, near the Saudi Arabian border, to an increasingly thirsty Amman, with a total distance of about 325 km and an estimated cost of US$ 600 million (for the location of DAS, see Fig. (10)). This means that a cubic meter of water will reach Amman at about US$ 0.60-0.85 (Jordan Business, 2007; JSE, 2008a). Because DAS lies in the desert, little recharge is expected to replenish it. Government spokesmen suggested that the water will last some 50-100 years (JSE, 2008a). Studies of stable and radiocarbon isotopes of the Disi water suggest that it is over 25,000 years old (Bajjali and Abu Jaber, 2001). With regard to the DWCP, some worrisome findings published in a recent study (Vengosh et al., 2009) indicated high levels of radioactive isotopes in the water of DAS (Salem, 2009; Wardam, 2009).

Commenting on the RSDSC Project, “It is not the only solution to the water problem, neither is it going to undo the mismanagement of the Jordan’s water resources,” Dureid Mahasneh, former Secretary General of the Jordan Valley Authority (JVA), explained. He added, “Re-exporting water in the form of watermelons and tomatoes is part of the Jordan’s mismanagement that also has to stop,” (El-Shamayleh, 2007). In the words of Gidon Bromberg, Israel’s Director of FoEME, suggesting alternatives for the RSDSC Project: “Our vision is based on water sharing, water conservation technologies, sustainable agriculture and sustainable tourism. The Peres [Israeli President Shimon Peres]-Tshuva [Israeli billionaire Yitzhak Tshuva]-World Bank vision may lead to ecological disaster;” (Bromberg, 2008a).

David Meehan (study team leader for the French consulting company ‘Coyne et Bellier’) said that he had encountered a number of amusing suspicions in his meetings with locals along the projected routes of the
RSDSC Project, including a Jordanian who wondered if it was an Israeli plot to realize a 'Talmudic Prophecy' that “one day fish will swim in the Dead Sea” (Reuters, 2009; BIC, 2009a). As many Jordanians have strong suspicions about the Israeli intentions of the RSDSC Project, the Jordanian government announced just recently (in May 2009) that it will go alone (without Israel) with the controversial Red Sea-Dead Sea Conveyance Project (GreenProphet.org, 2009c). David Meehan, however, came to the conclusion, even before ending the two-year FS which is undertaken by his company, as he said, “Technically and engineering-wise it [the RSDSC Project] was always going to be feasible. But there are some major issues that could determine its feasibility ultimately,” (Reuters, 2009).

Commenting on the supportive comments of the French President, Nicholas Sarkozy, in regard to the RSDSC Project, Munqeth Meyyar, Jordan’s Director of FoEME, said, “French President Sarkozy appears not to realize that he has stepped into a mine field of controversy. The project [RSDSC Project] ideas of building an open canal across the desert, Dubai style hotels, Las Vegas casinos, and African safaris are unprecedented in size, not only for the Middle East but globally.” He added, “They threaten to completely alter the World Heritage values of the Arava Valley [Wadi Araba] and the Dead Sea itself.” (GreenProphet.org, 2009d). Gidon Bromberg (Israel’s Director of FoEME) was equally damning of the Project, as he said, “Since time immemorial it was the Jordan River that replenished the Dead Sea. In just 50 years we have managed to turn the holy Jordan River into a sewage canal and dry up a third of the Dead Sea,” (GreenProphet.org, 2009d).

While the RSDSC Project is generally rejected by the public, scientists and environmentalists (as discussed above), Jordanian, Palestinian, and Israeli governmental officials from the Kingdom of Jordan, Palestinian National Authority, and Israel are, on the other hand, strongly pro the Project. These are some examples on their supportive positions to the RSDSC Project.

The current Secretary General of the Jordan Valley Authority (JVA), Moussa Jamaini, said, “The Kingdom [of Jordan] was fully committed to the Red-Dead conveyance action,” stressing that “the country is in a ‘dire need’ for the project. The Red-Dead scheme would help end the country’s large water deficit that stands at 400 million cubic meters of water annually.”
He added, “This is the best project to provide water [through desalination plants] and preserve the Dead Sea from vanishing.” He continued, “If the Dead Sea is not rescued, a major disaster to the environment will occur in the area. All the sinkholes in the area will turn into muddy areas with the drop in the water level - and this is very unsafe to people,” (The Jordan Times, 2008; JEW, 2008). The JVA official explained that with the decrease of the water level in the Dead Sea, underground water will start moving towards the Dead Sea; the lowest area in the world, and thus the limited quantities of underground water in Jordan will disappear with the passage of time.

Shaddad Attili, Head of the Palestinian Water Authority (PWA), stressed that the Palestinians are committed to the DSRSC Project. “Palestine has rights to part of the Dead Sea coastline, and Palestine shares the concerns of other parties over the drop in the water level of the Dead Sea and wishes to conserve that unique resource,” (The Jordan Times, 2008; JEW, 2008). He continued, “In addition, the present plans suggest that Palestine would receive a significant volume of desalinated water from the Red Sea-Dead Sea Project, were it to be constructed.” He explained, “Palestine has by far the lowest availability of freshwater of any of the countries bordering the Jordan River Basin, and one of the lowest availabilities of freshwater of any country in the world,” (The Jordan Times, 2008; JEW, 2008).

Noga Blitz of the Israel Water Authority also underlined that Israel is fully committed to the RSDSC Project, saying, “The region needs a solution for the decline of the Dead Sea as well as additional sources for freshwater, given the fact that all natural resources are depleting.” He added, “The proposed conveyance addresses both needs: Israel is deeply interested in saving the Dead Sea and the creation of a source for desalinated water for use in the region,” (The Jordan Times, 2008; JEW, 2008).

Stephen Lintner (World Bank’s Senior Technical Adviser) and Alexander McPhail (World Bank’s Lead Specialist) stressed that the RSDSC Project is a proposed action by the three beneficiaries (Israel, Jordan, and PNA) with a primary objective of saving the Dead Sea and a secondary objective to generate power and desalinate water. They added that the three beneficiary parties will review the findings of the studies and consider the next steps they may wish to undertake (The Jordan Times, 2008; JEW, 2008).
ADVANTAGES AND DISADVANTAGES OF THE RSDSC PROJECT

Advantages
The RSDSC Project is supposed to transfer annually about two billion cubic meters (BCM/yr) of sea water from the Red Sea to the Dead Sea. It is expected that the Conveyance will generate 800-850 MCM/yr of drinking water (almost half of the existing annual water use of Jordan), which would be divided amongst Jordan, Israel and the Palestinian Authority Territories (see Table (2)) (JSE, 2008b; Sabbah, 2009; IRIN, 2009; Lipchin 2009). The rest of the transferred sea water (about 1,200 MCM/yr) will be discharged into the Dead Sea. One or more desalination plants (using seawater reverse osmosis (SWRO) technology) and hydropower facilities will be built at a later stage of the Project. Table (2) shows that the Palestinians will get, in the year 2020, the lowest amount of the desalinated water (about 10%), though they are the most thirsty in the region, taking into account that Israel takes illegally more than 85% of the Palestinian water (Salem and Isaac, 2007). The Israelis will get about 20% and the Jordanians will get about 70%. As seen in Table (2), the desalinated water will increase gradually until it reaches its highest amount (850 MCM/yr) by the year 2060.

Table 2: Amounts of desalinated water from the RSDSC Project allocated to each of the beneficiary parties, as projected for the period of 2020-2060 (after Lipchin, 2009).

<table>
<thead>
<tr>
<th>Beneficiary Party</th>
<th>Potable Water Supplied from the Project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Million m³/year</td>
</tr>
<tr>
<td></td>
<td>2020</td>
</tr>
<tr>
<td>Jordan</td>
<td>220</td>
</tr>
<tr>
<td>Israel</td>
<td>60</td>
</tr>
<tr>
<td>Palestinian Authority</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
</tr>
</tbody>
</table>

Those who support the RSDSC Project claim that the potential advantages of the Project are substantial, which include the following:

Economic Boost
The proposed RSDSC Project would have economic development impacts, like the promotion of tourism on both sides of the Dead Sea, and marketing
and expansion of tourism of the Sea. A 12-year old study (TED, 1997) estimated that the economic benefits to tourism (based on a comparison of tourism potential with and without the RSDSC Project) would amount to US$ 320 million per year (no recent estimates are available). As regard to tourism industry in the Project’s area, some observers argue that the beneficiary parties could benefit from increased tourism in the area, as a result of the construction of the RSDSC, by building tourist health centers, clinics and spas in larger numbers. For instance, some argue that the Japanese ‘Onsens’ (natural hot springs) (Wikipedia, 2009b), where an entire culture has grown around, can be used as an example on Onsens enriched with health-laden minerals in the area of the RSDSC Project.

Construction of hydropower facilities and desalination plant(s), along with the construction of the Conveyance itself, will take several years. Those who are in support of the Project argue that if such a project will be undertaken, there will be a large workforce and development of new economic activities. Apparently, during the operational stage, the Project will probably represent a considerable source of revenues for local communities. It is believed that the accessed roads, local availability of electricity, and other activities associated with the Project are all possible sources of sustainable economic and social development.

Another economic issue is the cost of water. The cost of fresh water produced by hydro projects on the coasts of the Dead Sea would have to reflect investments in, and maintenance of, the Conveyance system and the desalinization plant(s), as well as the hydropower facilities. Although infrastructure is expensive, the price of desalinated water has decreased in recent years. In the early 1980s, the unit cost was US$ 1.2 per cubic meter, and by 1994, the cost dropped to US$ 0.6-0.7 per m³ (TED, 1997). In 2007, the cost was estimated at US$ 0.58-0.67 per m³ (Beyth, 2007). However, these are the prices the desalination lobbying groups usually present. It should be noted that these prices – at the best case – represent only the net energy costs to produce fresh water at the site of the plant – comparable to the pure pumping costs for groundwater up to the well head only, which is US$ 0.01 in the Gaza Strip and US$ 0.1 in the West Bank (personal communication). This is, of course, true if Palestinians
have control on their water resources. However, other sources, not linked to the large energy and desalination monopolies, suggest that the prices of the desalinated water would be doubled or even tripled by the end of the RSDSC Project which may take up to 25 years (The Guardian, 2009a), taking into account the water scarcity in the region, the high rates of population growth, higher consumption, and climate change impacts.

Additional economic returns might include: energy towers and solar energy ponds; expansion of fish culture in reservoirs and fish farms; expansion of water sports; and opportunities for investment in industries (such as plastic manufacturing, aggregate processing, metal fabrication, repair workshops, and a possible communications’ network serving the RSDSC Project). Apparently, all of these side-benefits would create jobs.

More Water Availability

Despite the fact that the RSDSC Project would be costly and its economic benefits are unclear, the desalinated water generated from the Project could help in more agricultural production and land rehabilitation, as water becomes, presumably, more available. Desalinated water would also boost agriculture and help alleviate the region’s water shortages. It could also spark regional cooperation.

The desalination component of the Project is, particularly, attractive to Jordan, as it would increase its total national water supply by a considerable amount (Hersh, 2005) (see Table (2)). Israel on the other hand, although having a plenty of water (in comparison to Jordan and the Palestinian Authority Territories), has actively sought and developed alternative water sources, such as desalinization of sea water obtained from the Mediterranean Sea. For example, Israel built in 2005 a desalinization plant in Ashkelon (Asqalan) with a capacity of 110 MCM/yr, and it has also plans to build more desalinization plants with a capacity of 500 MCM/yr by the year 2010 (Water Technology.net, 2005; Hersh 2005). Furthermore, in addition to the 340 MCM/yr of wastewater effluent which was treated and reused by Israel in 2003, Israel has plans to treat and reuse 500 MCM/yr by 2010 (FoEME, 2005).
As indicated above, Israel is mostly dependent upon the water diverted from the Tiberias Lake and the Jordan River, and upon the water pumped from the Palestinian Mountain Aquifer System (MAS, comprised of three major basins; Eastern, North-Eastern, and Western), underlying the Occupied Palestinian West Bank. Just to emphasize, Israel, since 1967, has been illegally using up to 85% of fresh water pumped from MAS, in violation of international law, while allowing the Palestinians to use only 15% or even less from their own waters in MAS (Salem and Isaac, 2007).

It is important to mention that, in Israel, over 50% of the water is directed to agriculture, yet that sector represents only 2-3% of the country’s GDP (Gross Domestic Product) (Humphries, 2007; Isaac and Salem, 2007; Salem and Isaac, 2007; and Salem, 2009). In view of these facts, Israel, water-wise, is much less reliant on the RSDSC Project, though it is strongly supporting it.

**Hydroelectricity**

The seawater would be pumped from the Gulf of Aqaba, at an elevation of about 170 m above sea level. Then the water will flow by the force of gravity to the Dead Sea at approximately 420 m below sea level. The ca 590 m (170 + 420) head differential would generate annually about 550-860 megawatt (MW) of electricity (Hersh, 2005; Ha’aretz, 2006; JSE, 2008b). This generated electricity will be used to: 1) power the initial pumping of sea water into the RSDSC; 2) desalinate about 800-850 MCM/yr of sea water. According to JSE (2008b), official statements on the Project suggest that it will take about 1 kwh (kilo-watt-hour) to desalinate 1 m³ of saline water that will be transferred through the RSDSC; and 3) despite the fact that the Project will generate modest amount of electricity which will be barely enough to power the initial pumping and to desalinate the transferred saline water, Hersh (2005) mentioned that the Project might yield some 100 MW of surplus power. It is noteworthy to mention that the power generated from the RSDSC Project is not a conventional hydropower. Everything will run with highly corrosive seawater. This means that all parts of the facilities have to be built with special and expensive materials, which is a quite difficult and costly task, and certainly is not straight forward.
Reverse of Dead Sea Damage

Building the RSDS Conveyance would reverse the damage caused to the Dead Sea, as some observers claim. This is, however, not an easy task. According to a policy document prepared by several Israeli institutions and submitted to the Israeli government, the RSDSC Project would reverse the decline of the Dead Sea water level, but it will take so many years to happen (JIIS, 2006). However, if this would take place, it might, according to the Israeli policy document, positively impact the tourism and potash industry sectors. It could also slow down the formation of sinkholes in the Dead Sea area, and it would restore the Dead Sea’s unique ecosystem, as some observers claim. Some others argue that the Project could have a positive impact on the Mountain Aquifer System (particularly the Eastern Basin of it), which is currently drained and stressed, as a result of increasing brackish and saline spring flow due to the sea level drop. Some others, in contrary, see the opposite (see below, under ‘Damage to Groundwater’).

PNA’s Full Partnership

Since the signing of the ‘Peace Treaty’ between Jordan and Israel in 1994, both nations have been progressing towards the necessary level of cooperation. Some observers argue that the inclusion of the Palestinian National Authority (PNA) into a tri-national (Jordan, Israel and PNA) agreement, as a ‘Full Partner’, would likely have beneficial implications within the overall ‘Middle East Peace Process’. Some others ask, however, what is the benefit of being a full partner in the RSDSC Project, while Palestinians are not allowed to get to the Dead Sea shores, for example? What does it mean to be a full partner in the Project while Israel, since it occupied the Palestinian Territories in 1967, never stopped stealing the Palestinian water, in violation of international law? What does it mean to be a full partner in the Project, while Israel has been steadily violating the ‘Oslo Peace Agreement’ since it was signed in 1993 between the Palestine Liberation Organization (PLO) and Israel? Also, what does it mean to be a full partner, while Israel has never stopped building its illegal settlements in the Occupied West Bank, including East Jerusalem, and has isolated the
Palestinian communities in cantons, as a result of the hundreds of the Israeli checkpoints spreading all over the Occupied Palestinian Territories, and of the ca 700-km long Segregation Wall surrounding the West Bank? Some others ask, what does it mean to be a full partner, while the Palestinians are still paying a heavy price as a result of the two full-scale wars that Israel launched against them? That was in 2002 and 2004 when Israel invaded the West Bank, and in December 2008-January 2009 when Israel used all military force against the Gaza Strip.

**RSDSC Project’s Disadvantages**

Apart from the advantages of the RSDSC Project (as seen by those who support it), the Project has a plenty of negative impacts (as seen by those who oppose it), economically, socially, environmentally, seismologically, climatically, ecologically, agriculturally, limnologically, archaeologically, politically, geopolitically, water-wise, tourism-wise, health-wise, etc. These disadvantages are:

**Price Tag**

The RSDSC Project would be costly and expensive, and its economic benefits may be unclear. Some observers, however, believe that the large funds that have been or will be spent on the Project could be invested in more feasible projects that may have more positive and direct impacts on the socio-economic life of the populations in the region.

The price tag for the ca 25-year Project is estimated to require somewhere between US$ 5 and 10 billion in capital (The Jordan Times, 2009b). According to the FoEME (2008), the total cost of the RSDSC Project, including the construction of the planned hydroelectric power plant and the desalinization plant(s), as well as a water distribution network are projected to approximately US$ 5 billion, at least. Some other sources gave a higher cost estimate for the Project, which is in the range of US$ 14-15 billion (Doherty, 2008; Kraft, 2009). These estimates, ranging from US$ 5 to 15 billion, are discouraging and really daunting.
Damage to Groundwater

Along the RSDS Conveyance alignment, there are some concerns that leakage or a spill of seawater would contaminate the freshwater in the underground aquifers on both sides of the Conveyance. The groundwater in the area will be potentially contaminated, due to transportation of seawater over a distance of 180-200 km and the surrounding area (TED, 1997). Transporting seawater in a pipeline, tunnel, or open canal through the Arava Valley (Wadi Araba) – an area where earthquakes regularly occur (as discussed below) – would likely lead to spills and, thus, salinization of the groundwater in the area of the Project (Bromberg, 2008b). Eilon Adar, Director of the Israeli Zuckerberg Institute for Water Research at Ben-Gurion University of the Negev (Naqab), warned that major natural engineering projects inevitably create negative impacts. He explained that a canal rushing with seawater in a seismologically volatile valley could spell disaster for the area’s underground freshwater aquifers. A leak from the Conveyance for several days could contaminate all – or at least a significant portion of – the aquifers (GreenProphet.org, 2008).

In addition, the wastewaters from the production and living areas of the Conveyance’s construction can affect the surrounding water environment, causing probable contamination to the groundwater. This, in turn, could be disastrous to all who will depend on the Project, including, of course, the local populations in the region, as they will be directly affected.

Three main aquifer systems in the area, where the RSDSC Project will be carried out, are utilized along the Wadi Araba by Jordan and Israel. The most exploited of these is the Shallow Wadi Araba Aquifer System (SWAAS). The other two aquifer systems in the Valley (Wadi Araba) are deeper than SWAAS. The water in SWAAS is of low salinity (brackish water) and of prime importance both to agriculture and for the tourism industry.

Since there is nothing such as hundred percent sealing, the susceptibility of these groundwater resources to continuous leaks or sudden spillovers from the RSDSC should be a major concern, and it may cause a disaster for the underground freshwater aquifers. Also, there is a risk of polluting the groundwater from the drilling process when installing feed-water
pumps for the desalinization plant(s). Leakage from pipes that carry feedwater into the desalinization plant(s) and highly concentrated brine out of the plant may percolate underground and cause harm to the groundwater aquifers in the region.

In conclusion to this, seawater pipes laid over aquifer systems pose a danger to them, as pipes may leak and saltwater may penetrate the aquifer systems. As a result, the laying of these pipes, if the Project will be undertaken, requires the use of proper sealing techniques. Also, the site of the desalinization plant(s), where the possibility of causing considerable harm to the groundwater is high, should be carefully examined.

**Damage to Red Sea Coral Reefs**

The RSDSC Project would restore the Dead Sea water level, but other potential environmental key impacts are not yet well understood, such as a potential damage to coral reefs in the Red Sea. The Red Sea encompasses 200 different species of corals in its waters (TED, 2003) (see Fig. (13)). The declining state of coral reefs is caused by increasing activity in construction and tourism along the Red Sea coastline. At the upstream-most end of the Conveyance, the massive intakes may affect the marine ecosystem and the sensitive coral reefs of the Gulf of Aqaba, where the ecosystem is a scuba-diving Mecca.

![Figure 13: Red Sea Coral Reefs (after Google, 2009).](image)
Some Israeli sources, such as Ha’aretz (2008) and JewishJournal.com (2008), reported that the RSDSC Project will cause damage to the coral reefs in the Gulf, due to the extensive pumping of sea water. Amazia Genin (professor at the Interuniversity Institute for Marine Sciences in Elat) believes that such a project could change the water flows in the Red Sea and harm the coral reefs (The Epoch Times, 2008). The coasts of both of Israel and Jordan at the Gulf of Aqaba are extremely short – a handful of kilometers each – and almost completely built up. In order to suck in a huge amount of saline water (2 BCM/yr) and pump it up to a height of about 170 m (as discussed above), one needs to create and dig in a huge new bay. Taking into account that the coral reefs in the Gulf of Aqaba are already under immense stress and dying gradually, this process will simply wipe them out.

**Limnological Damage (Mixing of Red Sea and Dead Sea Waters)**

Both limnologists and potash industrialists are concerned about the anticipated stratification, intensive precipitation of gypsum, changes in the Dead Sea biogeochemistry, anoxia, and algal blooms in the would-be less saline new water of the Dead Sea. The water column in the Dead Sea is stratified, as a result of salinity variations with depth. The Dead Sea salinity is 250 g/kg (gram per kilogram) at the surface, 25 g/kg at a depth of 35-40 m, and gradually changing down to 80 m (TED, 1997). The salinity of the Dead Sea is 11 times as much as that of the Red Sea. It is about 33.7% for the Dead Sea, while it is about 3.7% for the Red Sea (Wikipedia, 2009c, 2009d).

Depending on the desalination removal efficiency, the Red Sea water discharged into the Dead Sea will have a much less salt concentration than the Dead Sea brine. Changes in the Dead Sea salinity, as a result of mixing of both waters of the Red Sea and the Dead Sea (with a salinity ratio of about 1:11), will have a devastating impact on the chemical composition of the Dead Sea. This will, in turn, affect the economy of the region, especially health tourism and potash mining. Some scientists have shown that mixing of the waters of both seas (Red and Dead) would lead to algae blooms, causing the Dead Sea to both change color (from turquoise to brown) and loose much of its famous buoyancy (The Economist, 2007).
The effects of mixing the biologically-rich Red Sea water with the chemically-rich Dead Sea water are unpredictable. However, according to Gavriele et al. (2005), dilution of the Dead Sea surface water will most likely result in ‘microbial blooming’ with unknown duration. Furthermore, the lower layers of the Dead Sea water are likely to develop reducing conditions, which may result in ‘bacterial sulfate’ reduction and presence of hydrogen sulfide (H₂S). Mixing between the calcium (Ca)-rich Dead Sea brine and the sulfate (SO₄²⁻)-rich Red Sea saline water will result in precipitation of ‘gypsum’ (CaSO₄ · 2H₂O). So, in spite of the large volume of the Dead Sea water and its high salinity (relative to that of the inflowing water from the Red Sea), the unique chemical composition of the Dead Sea water will definitely be changed over the long run and the short run as well. In addition, precipitation of gypsum in large amounts will create a white cover on the Dead Sea shores and its bottom; so the health spa mud will be ruined.

**Damage to Archaeological Sites**

The World Bank’s ‘Terms of Reference’ (ToR) for the RSDSC Project mentions the potential danger to archaeological and historic sites during the construction phase of the Conveyance (WB, 2007). It acknowledges, however, the archaeological importance of the region, and at the same time, the fact that the Project is virtually certain to encounter archaeological sites. The area of the RSDSC Project is of high archaeological, aesthetic, and cultural values. Another concern is that the pipelines of the Project will cross areas of high archeological heritage in the Wadi Araba area, such as the Wadi Finan, where the earliest copper mining and extraction in the world took place (Wikipedia, 2009c).

**Seismological Activity and Earthquake Risks**

Wadi Araba (Arava Valley) is located between the Gulf of Aqaba in the south and the southern tip of the Dead Sea. This depression, covered with alluvial and lacustrine deposits of late Pleistocene and Holocene age, is cut along its entire length by the ‘Dead Sea Transform Fault’ (DSTF) (Klinger et al., 2000) (see Fig. (8) and Fig. (14)). The DSTF system has led to
the formation of alternating extensional grabens and compressional folds along its length.

The sedimentary basin, which is cut through by the DSTF, is about 10 km thick, attestign to a rather rapid subsidence (Ben Avraham, 1997). This sedimentary basin is tectonically active (Garfunkel et al., 1981; NASA, 2009), as it presently generates the most intensive earthquake activity between the Gulf of Aqaba and the Lebanon’s Biqa’a, including the destructive earthquake of 6.3 magnitude, occurred in 1927 (Shapira et al., 1993). Basin effects are expressed by amplification of the ground motion and the prolonging of their duration and, thus, they may cause substantial damage, even if the source earthquake is distant in location or moderate in intensity (Begin et al., 2005).

The Dead Sea is located in the Jordan Trough of the ‘Great Rift Valley’ (also known as ‘Jordan Rift Valley’) (see Fig. 14). The DSTF system is located between the two tectonic plates of the Arabian Peninsula (main part of the Arabian plate) and the Sinai Peninsula (part of the African plate), running through the Dead Sea region (see Fig. (8)). About 105-km displacement of the Arabian plate (northward movement) relative to the African plate (southward movement) took place over the last 20 million years (GFZ, 2008).

The DSTF is a left-lateral strike-slip fault system, with a slip rate (or rate of movement) ranging from 2 to 12 mm annually (Klinger et al., 2000), and an average rate of 5 mm/yr (Wdowinski et al., 2004). This kind of fault exhibits a movement that is mostly horizontal and parallel to the strike. The DSTF transfers the opening at the Red Sea to the Taurus-Zagros’ collision zone (in Turkey) and runs along the Arava Valley (Wadi Araba) between Historical Palestine and Jordan.

The DSTF system represents a 160-km stretch zone from the Gulf of Aqaba in the south to the southern tip of the Dead Sea in the north (Makovsky et al., 2008). It is an active fault, posing a major seismological threat to the population in its surroundings, and hence, an earthquake mitigating building code was adopted in Israel (Begin et al., 2005). The DSTF has been the source of many historical large earthquakes (Haynes et al., 2006) (see Fig. (14)).
Figure 14: Seismicity map for the Jordan Rift Valley and Eastern Midterranean, showing locations of earthquakes (in red) with magnitude (M) ranging from 5.1 to >7.0 (after GFZ, 2008).²

One of the relatively recent devastating earthquake occurred in 1837 just north of the Tiberias Lake, with a magnitude (M) of 6.3 (GFZ, 2008). That earthquake, with epicenter possibly near Safad, killed about 2,100 people and caused huge damage to buildings in Safad, Tyre and Sidon, and moderate

² Large earthquakes from year 1000 to year 1900 are given as red dots together with their estimated magnitude. Large earthquakes from year 1900 to year 2004 are given as stars (including year and magnitude). Seismicity from 1984 to 2004 is given as small white circles. The dashed red lines indicate the major faults (Fig. 14; after GFZ, 2008).
damage to buildings in Nazareth, Haifa, and Hebron (Ameran et al., 1994). Another relatively recent devastating earthquake occurred in 1927 (some 82 years ago), in the north-western end of the Dead Sea\(^3\), with M of 6.3 (as indicated above), and was generated by the DSTF (Begin et al., 2005). It killed between 250 and 500 people and injured 400-700 people. It also caused heavy damage in Nablus and to the domes of the Church of the Holy Sepulchre and Al-Aqsa Mosque in Jerusalem. Furthermore, many buildings were damaged, landslides and rock falls were detected along the road from Jerusalem to Jericho, and the flow of the Jordan River stopped then for 21.5 hours (Amiran, 1951; Zohar, 2004; USGS, 2004; Wikipedia, 2009e).

The two major earthquakes (occurred in 1837 and 1927, both with M of 6.3) indicate that they struck the region within a period of only 90 years. Does this mean, statistically, that the next devastating earthquake (with M of 6-7) might occur in the region within the next 10 to 30 years at most (i.e., roughly between the years 2017 and 2040)? Let us wait and see. Recent estimates, however, suggest that strong earthquakes with a magnitude of 7.0 or higher would take place along the DSTF zone every 200 years or so (Klinger et al., 2000), and/or with a magnitude of 6-7 every 100 years or so (GFZ, 2008).

According to Migowski et al. (2004), there have been several major earthquakes along the DSTF (starting from the Red Sea in the south and catching up with the East Anatolian Fault line in south-eastern Turkey). This is, on average, one major earthquake every one hundred (100) years. This pattern is clear for the last 2,000 years or so. These major earthquakes have been spaced variably very close to the Dead Sea, but also up to about 400 km along the Rift, making an even distribution of earthquakes across the Levant. A description of 11 historical major earthquakes (occurred between the years 551 and 1837 and took place in the Dead Sea-Wadi Araba area) is given in Haynes et al. (2006). The intensity of the destructive

\(^3\) It is noteworthy to mention that the distance from the epicenter of the last devastating earthquake occurred in the Dead Sea (1927; M = 6.3) to Jericho, Jerusalem, Amman, and Nablus is 25 km, 25 km, 60 km and 70 km, respectively (GFZ, 2008). This means that none of these cities is really safe from a major earthquake that might hit the region anytime in the future. Earthquakes along the DSTF and in the Dead Sea Basin itself pose, therefore, a considerable seismological hazard to the whole region, including Israel, Jordan and Palestine (GFZ, 2008).
capability of an earthquake depends on its distance (hypocenter) and depth of origin (epicenter), which is also known as ‘focal depth’.

In addition to the major earthquakes that struck the region through history, minor earthquakes and small tremors are constantly recorded. Recently, a series of them, ranging in magnitude from 3.0 to 5.1, have been recorded (WordPress.com, 2007). For example, the February 2004-earthquake (M = 5.1) occurred in the north-west region of the Dead Sea (at about 16 km south of the city of Jericho), with a focal depth of 21 km. This earthquake was felt in the Palestinian cities of Jericho, Hebron, Nablus, Ramallah, Bethlehem, and Jerusalem, but no life loss was reported (Al-Dabbeek et al., 2004; El-Kelani, 2004).

As related to the RSDSC Project, Egypt, as a neighboring country, has voiced strong opposition to the Project, because of its implications in a seismologically active region (Wadi Araba-Dead Sea-Jordan River-Tiberias Lake), and because of belief that Israel will use the RSDSC Project to supply additional cooling water to its nuclear facility in ‘Dimona’ in the Negev (Naqab) Desert (Jarrar et al., 2004; Hersh, 2005; RedOrbit, 2005). Concerning potential construction of desalination plants in the region, Hamadneh (1984) and Mohsen (2007) mentioned that risks may be produced as a result of the seismological activity in the region.

One can conclude that the tectonic activity along the Wadi Araba and the Dead Sea is complex and can endanger the facilities that may be constructed on both end-points of the Red Sea-Dead Sea Conveyance (RSDSC). Geologists and seismologists predict (given the 2-12 mm annual slip rate) that the DSTF, running through the Wadi Araba (where the RSDSC Project is supposed to be constructed), could trigger severe and highly destructive earthquakes with shallow epicenters and high magnitudes, which may endanger the RSDS Conveyance and its related facilities (El-Atrash et al., 2008). Moreover, there are some concerns that using huge amounts of explosives to dig for the RSDSC, and the rush of large quantities of water in the region through the Conveyance, as well as the Israeli nuclear tests conducted in the neighboring region will probably lead to strong and more frequent seismological activity, including natural earthquakes as much as induced ones, resulted from man-made seismic activity.
Health Risks

The World Bank (WB), which strongly adopted the RSDSC Project, raised (in its ‘Terms of Reference’ (ToR) of the Project) the issue of transmissible diseases as a task to be investigated under the Environmental-Social Assessment (ESA) study of the Project. The WB, accordingly, suggests a health and HIV/AIDS (Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome) management plan to provide a framework to protect the health of, and prevent transmission of sexual diseases to, the employees and the public during the construction and operational phases of the Project (WB, 2007). This issue, however, is not only important but problematic and risky too. So, one has to tickle it with extra care and sensibility (i.e., with keen intellectual and cultural perception). The WB, nevertheless, does not have any clear indicators for health risks other than the alleged but unsubstantiated claims of diseases’ transmission, including HIV/AIDS, though extra care should be considered.

Damage to Tourism

The DSRSC Project might have good impacts on tourism industry – but only if we define tourism not as sustainable/ecological/sensitive to nature and culture – (as discussed above). This is because more water discharged in the Dead Sea means elevating the Dead Sea water level and, thus, saving the Dead Sea from further decay. The Conveyance might also have bad impacts on tourism industry. This means that the addition of water from the Red Sea to the Dead Sea will change the make-up of the Dead Sea hypersaline water that has a unique chemical composition and extremely high salinity (as explained above). This, in turn, might eliminate the therapeutic benefits of the Dead Sea water and mud, and, thus, health and spa tourism will be severely harmed.

Damage to Landscape

A landscape is defined as an expanse of scenery that can be seen in a single view. The Dead Sea-Wadi Araba area (where the RSDSC Project will be undertaken if approved), represents many marvelous landscapes with
attractive nature and unique characterization. They are considered some of the most spectacular natural, spiritual, and archaeological landscapes in the world. The desert between Wadi Araba and the Gulf of Aqaba is awe inspiring in its beauty and extraordinary landscape. It is a region filled with beautiful nature and attractive views, as much as history and revolutions. The Wadi Araba-Dead Sea area forms a natural boundary, as it is part of the Great Rift Valley, which carves a passage further southwards through East Africa. With regard to the RSDSC Project, a huge damage to the natural landscape and the ecosystem of that area will be caused as a result of the Project, due to the construction of the Conveyance, desalination plants and hydropower facilities, using heavy machinery. This is also due to the increase in humidity caused by the open canal segments, as well as many other factors. Damage to the landscape is certainly associated with damage to biodiversity in the area.

**Damage to Biodiversity**

The RSDSC Project could result in a high magnitude impact on species, by affecting an entire population or species in a sufficient magnitude. This would cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it to its former level within several generations, or when there is no possibility of recovery. Some of the fauna can be disturbed by noise, lighting, and vibrations produced by construction. The most popular species groups in the area, such as ibex, hyena, jaguar, bear, lion, etc., are already extinct or on the verge of being so. The few specimens (of many species) left, will surely not survive this catastrophic Project.

Also, introducing non-native invasive species to the region can cause significant and long-term disturbance to native species and their habitats. Planting ‘non-native invasive or alien species’ ¹, or bringing in non-native invasive or alien species onto the site of the Project will damage

¹ ‘Invasive species’ means an alien species whose introduction is likely to cause economic or environmental harm to human health (NISC, 2006). ‘Alien species’, with respect to a particular ecosystem, means any species, including its seeds, eggs, spores, or other biological material, that is capable of propagation and is not native to that particular ecosystem (NISC, 2006).
the sensitive, already stressed ecological balance and can result in harm to human health, especially if the ‘Las Vegas-Style Peace Valley’ option of both of the Israeli President Shimon Peres and the Israeli real estate magnet Yitzhak Tshuva will be pursued (see above).

Changes, which will be introduced to the area by the RSDSC Project, will surely result in long-term impacts on biodiversity, habitats, and ecosystems. These impacts, which can be significant, would take different forms: 1) Building pipelines or roads in areas that have previously been inaccessible for development; 2) Heavy construction for the gigantic mega Project itself, including new infrastructure, leading to a significant population increase in the area; 3) Building monumental tourism sites (up to 1-2 million new beds envisaged in the worst scenarios); 4) Vast expanses of garden-city style and heavily irrigated lands will simply wipe out the precious and vulnerable desert vegetation and fauna; and 5) Introducing a plenty of water onto the area will lighten the weather, rejuvenate the life of some plants in the area, and add to the spread and growth of some other plants, which all result in causing disturbance to the area’s biodiversity.

**Impacts on Weather and Climate**

For many decades now, as indicated above, Jordan and Israel have been using large quantities of water from the Dead Sea, diverting water from the Jordan River and its tributaries, and pumping (in the case of Israel) water from the Tiberias Lake. *These processes have all led to increased water vapor in clouds. Competition for increased water vapor in clouds, resulting from more evaporation rates that caused by more diverted water, usually divert wind systems, extend cold temperatures, and intensify aridity (Bryant, 1997).* Having said that, the climate in the region has become more arid and the water flow of the Jordan River, from which desert plants draw much of their water intake, has nearly disappeared, which has led to more desertification in the region.

The weather patterns in an area change when large amounts of water

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5 Rejuvenation means: 1) To restore to youthful vigor (capacity for natural growth and survival, as of plants or animals) or appearance – make young again; 2) To restore to an original or new condition; 3) To stimulate (a stream) to renewed erosive activity, as by uplift of the land; and 4) To develop youthful topographic features in (a previously leveled area) associated with different species and habitats.
are introduced. As large amounts of water (about 5.5 MCM per day, as indicated above) would flow from the Red Sea to the Dead Sea through the Conveyance, the weather patterns will be affected. However, the consequences of the construction of such a mega project (RSDSC Project) on the climate, and its possible contribution to global warming and climate change are unclear yet. Some experts, however, believe that such a project, if undertaken, will certainly affect the climate of the rejoin, particularly at the long run (Salem, 2009).

Technically speaking, if parts of the Conveyance will be land-open (i.e., in the form of a canal but not piped or tunneled) of some 20-25 m width, extending over a long part of the path of the Conveyance (which is 180-200 km long), where large amounts of water will pass through every single day (roughly 5.5 MCM/d), then a big part of the transferred water will be exposed to open air. Consequently, the evaporation rates of the exposed water will be extremely high, especially in the presence of high temperatures and even expected higher temperatures in the future, taking into account the climate change scenarios (Salem, 2009). Higher evaporation rates, as a result of the large amount of water flowing through the land-open part of the Conveyance, will result in greater levels of humidity in the atmosphere. This would, in turn, affect, on the short run, the daily weather of the area and, on the long run, the climate of the region and the regions beyond (Salem, 2009). In contrary, some hydrology experts predict that, by building the RSDSC, the Dead Sea water level will gradually increase, as the amount of rainfall will naturally increase, resulted from the hydrological (evaporation-precipitation) circle. This may result in lowering the temperature and, thus, the climate pattern in the region will be disturbed. Nevertheless, nobody knows how accurate these predictions are.

Similar to the Conveyance, the construction of huge desalinization plant(s) and hydropower facilities in the area, as essential components of the RSDSC Project, could affect the daily weather of the area and, on the long run, the climate of the region. According to the ‘World Wildlife Fund’ (WWF), the desalinization process uses large amounts of energy, emits greenhouse gasses, and destroys marine life in coastal areas. In a public statement to the ‘Associated Press’ made by Jamie Pittock, who heads the WWF’s Freshwater Program, it is mentioned that, “The rate of building desalination plants seems to be growing exponentially. If that continues,
greenhouse gas emissions would accelerate and increase climate change dramatically,” (Euroresidents, 2007).

**Waste Disposal and Noise Pollution**

The construction process of the RSDSC Project can be time-consuming, noisy, and disruptive to the environment. A mega project, such as the RSDSC Project, usually involves large-scale construction operations that take a long period of time, a large number of construction workers, and heavy machines. During the construction process, activities like land occupation, quarrying, earth borrowing, and waste disposal will have major impacts on species and ecosystems (as explained above). In addition, the improper prevention measures may cause serious water quality problems, soil erosion, and soil contamination. Trees’ uprooting and clearing will result in soil erosion and landslides. The construction of water-intake structures and pipelines to carry feed-water and concentrate-discharge may cause disturbances to environmentally sensitive areas. Concentrates are high in salinity, containing high concentration of chemicals, which can pose problems for the marine habitats and for the receiving water environs.

Furthermore, seawater desalinization plants require the use of high-pressure pumps and turbines for recovering energy, causing high levels of noise. Also, construction of hydropower plants can alter considerable portions of land, as in the case of such mega projects like the RSDSC Project. In addition, as a result of dumping the dredging material produced during the construction stages of the Project, the rate of sedimentation in the neighboring marine environment will increase, which may result in destroying the ‘benthic habitat’<sup>6</sup>, especially in the Red Sea.

**Damage to Local Communities**

The state of Israel constantly bulldoze and raze Bedouin villages and small communities in the Negev desert as well as in the Dead Sea and

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<sup>6</sup> The term ‘benthic’ refers to anything associated with, or occurring on, the bottom of a body of water. The animals and plants that live on the bottom of a water body are known as ‘benthos’. ‘Benthic habitats’ can best be defined as bottom environments with distinct physical, geochemical, and biological characteristics. They vary widely, depending upon their location and depth, and they are often characterized by dominant structural features and biological communities (NOAA, 2009).
Wadi Araba region, calling the towns and communities of the Bedouins illegal and unauthorized. The use of house demolition, as an enforcement tool, is applied by Israel in a discriminatory and cruel manner against the Bedouin citizens in these areas. Since the beginning of 2007, Israel has demolished some 130 houses in Bedouin communities alone (ACRI, 2008). That would mean, for the Bedouins, giving up their traditional herding and farming lifestyle. The current Israeli President, Shimon Peres, said, “The Negev is the future of Israel. Cutting-edge science will bring new methods to produce water and harness the sun’s energy in the [Negev] Desert,” (NPR, 2007). This will certainly be at the expense of the Bedouins and their traditional way of life.

The most difficult part in calculating the impacts which the RSDSC Project would have on the Bedouins’ population in the area is ascertaining how many Bedouins there are in the area of the Dead Sea and along the Conveyance’s pathway in Wadi Araba. Such information is held secretive by the Israeli government, which does not share it with others, especially if we knew that these areas are militarized boundary zones, and, thus, they are out of reach for people from outside the area except for local inhabitants. It is known, though, that there are some 160,000-170,000 Bedouins in Israel, including those in the Dead Sea and Wadi Araba region (ACRI, 2008; Ben David, 2009). One half to two-thirds of them live in the Negev Desert, with many tens of thousands live in Israel (ACRI, 2008; Ben David, 2009) – all of which are not recognized by the state of Israel (ACRI, 2008). A rough estimate indicates that the number of Bedouins living in the Dead Sea-Wadi Araba region could be in thousands, including the 6,700 residents, living on the Jordanian side of Wadi Araba (Encyclopedia.com, 2007). The exact number of Bedouins living on both sides of the Dead Sea-Wadi Araba region (i.e., in Israel, Jordan and PAT) needs to be investigated. This requires Israel’s release of all information about them, in order to understand how these people would be affected by the proposed RSDSC Project.

It is believed, in view of the above, that the Bedouin communities do not need any further political, social, environmental or economic problems, because they have enough of them. Such a project, however, will cause the Bedouin communities in the area of the Project more problems. Apparently the Project will be overall catastrophic for the Bedouin population in the
area, who hold to the traditional and semi-traditional ways of life. First and foremost, it is important to realize that the Bedouins in the area are pastoralists and they depend upon the density of the local fauna. Any impacts, which the RSDSC Project may have on local plant populations (as explained above), will certainly affect the Bedouin communities. Bedouin communities have their own way of life, which is affected by the environment in which they live. To move the Bedouin communities to a different environment, if the RSDSC Project would be undertaken, will not only be an easy thing for them to accept, but, according to Cook (2003), it will be also disastrous. In addition, with such a mega project (RSDSC Project) to be built, Israeli settlers, as well as Jordanian and Palestinian communities on both sides of the Conveyance, will move near the Conveyance, chasing Bedouins who wish for having a more traditional life in their traditional grazing territories.

On this issue (i.e., the RSDSC Project’s impacts on the Bedouin communities in the area), it is believed that experts, not politicians or businessmen, need to be consulted. This should include international indigenous rights’ groups, such as the ‘United Nations’ Working Group on Indigenous Populations’ and the ‘Society for Threatened People’s International’, as well as human and civil rights’ groups. And, in the first place, of course, the ones who need be consulted are the Bedouins themselves.

**Endangering the ‘Water Rights’ for Palestinians**

“For Jordan, it [the RSDSC Project] is a water-supply project,” said Engineer David Meehan, who leads the study team for the French consultancy company ‘Coyne et Bellier’. He added, “While for Israel it has perhaps as much to do with regional politics. For them [the Israelis], desalinating Mediterranean water is much more practical. The Palestinians [on the other hand] have not even asked formally for a share of the desalinated water [generated from the RSDSC Project], possibly because they do not want to prejudice their existing claims to Mountain Aquifers. None of these issues can be separated from politics,” (Reuters, 2009; BIC, 2009a). In reality, however, any share of desalinated water that
the Palestinians could obtain from the RSDSC Project cannot and should not diminish their rights to the water resources in the region.

Nevertheless, a small part of the desalinated water produced from the RSDSC Project might go to the Palestinians (see Table (2)). Whether the Palestinians’ share a small part, a large part, or no part at all, it is believed that the Palestinian leadership should make it clear that the Palestinian people, regardless of the outcomes of the World Bank’s Feasibility Study (FS) and Environmental-Social Assessment (ESA) Study of the RSDSC Project, should not compromise on any of their rights in all of their rightful water resources. These include the West Bank’s Mountain Aquifer System (MAS) and the Jordan River Basin (including the upper and lower parts of the Jordan River and the Tiberias Lake), as well as the Dead Sea.

The Palestinian participation in the RSDSC Project should not, by any means, drop the Palestinian legitimate demands that Israel should stop its unilateral measures in the Jordan Valley, and that the international community and the multilateral organizations should exert pressures on Israel to start negotiation with the Palestinians on all the communal water resources (Deibes, 2005). In addition, the Palestinian leadership should confirm that the Palestinians have not only the full right but also – according to international law – the duty to withdraw or reject the RSDSC Project if the studies (FS and ESA) will prove that the Project affects, in a way or another, the Palestinian water rights, or to that matter, if the Israeli government persists on confiscating more Palestinian land to build more illegal settlements in the Occupied West Bank. (See in the beginning of this study what the Palestinian Prime Minister, Dr. Salam Fayyad, said in this regard).

**Endangering the ‘Right-to-Return’ for Palestinians**

In their study on developing options for sustainable water management in the region, Orthofer et al. (2007) suggested a “more sustainable development scenario” for water allocation in the Lower Jordan Valley. The scenario projects a population increase in the area (from 250,000 in the year 2000 to 1,100,000 in the year 2020); as it takes into account the “Palestinian refugees to be settled in that area.” It is clear that, while the Palestinians in Occupied East Jerusalem and other places of the West Bank
have been facing ethnic cleansing at the hands of the Israeli government and its Jewish settlers, Israel has already plans to settle these Palestinian citizens and possibly returning Palestinian refugees (who were ethnically cleansed from their homes and lands back in the year 1948, when Israel was established) in the Dead Sea-Wadi Araba area, as the Israeli government is being encouraged by the availability of more water and electricity to be generated from the RSDSC Project.

The idea of settling ethnically cleansed Palestinians and returned Palestinian refugees in the area of the RSDSC Project, so they can take advantage of the desalinated water and electricity that would be generated from the proposed Project, should be thoroughly analyzed, in view of international law, including the ‘Right-to-Return’. However, it must be crystal clear that the Jordan Valley and the area where the RSDSC Project will be constructed should not be used simply as places to dump ethnically cleansed Palestinians and Palestinian refugees. Accordingly, the RSDSC Project should not be used as an easy fix for Israel to solve a long-standing and intractable problem (the Palestinian refugees’ problem), which represents the core issue of the ongoing Israeli-Palestinian conflict, since the year 1948.

ALTERNATIVES TO THE RSDSC PROJECT

The regional countries and the international community view, as discussed above, the Dead Sea as a site of cardinal environmental, economic, and tourism importance, as well as a site of international significance and global attraction. As part of its efforts to ensure the long-term environmental integrity of the area, the FoEME has promoted registration of the Dead Sea Basin with UNESCO, as either a ‘Biosphere Reserve’ or a ‘World Heritage Site’ (FoEME, 2009). A fundamental assessment is required, in regard to a wide spectrum of implications that influence the economy, environment, industry, tourism, and other issues of the Dead Sea area.

“Given the cost, complexity and risks involved in the [RSDSC] project, many are asking why there isn’t more consideration of alternatives to halt the Dead Sea crisis,” BIC (2009b) argues. The alternatives to the RSDSC Project, which were previously rejected by the World Bank, should be revisited, evaluated, examined, and strongly reconsidered. This should be
done with the purpose of providing a context for the current situation, by setting out clearly the basis for the decisions to be taken. It should be done, however, despite the World Bank’s recommendations, stating that “the previously rejected alternatives are not to be re-opened” (WB, 2007). The following presentation reviews some alternatives of the RSDSC Project, which should be discussed by experts to decide which alternative fulfills the ultimate goal, environmentally, economically, socially, politically, etc., instead of the RSDSC Project.

No-Action

The ‘No-Action’ alternative means to leave the situation as is and not to do anything about it. Some experts who support this scenario argue that the Dead Sea will never dry out and will never totally disappear (see above). The Israeli policy document (JIIS, 2006) states, “The Dead Sea is not expected to disappear even if no measures are taken to change the negative water balance of today. Although water level will continue to decline in the coming years, it is likely to approach a stable situation in about 200 years at a level about 550 m below mean sea level. At this stage, the Lake’s [Dead Sea] maximal depth will be about 180-200 m and its surface area will have shrunk to 450 km².”

However, the negative impact of doing nothing is that the Dead Sea will become smaller and smaller in area and with less amount of brine in it. This may also inversely affect the tourism industry (especially the health tourism) and, in turn, the economy of the region. The positive impact of this alternative is that the nature of the Dead Sea will be fine, at least in terms of the chemical composition of the Dead Sea’s brine (hyper-saline water).

To Reduce Water Consumption from Jordan River and Tiberias Lake

The concerned governments, with pressure from the international community, should immediately work on gradually reducing the amount of water diverted from the Jordan River and that pumped from the Tiberias Lake. This alternative means that, within a period of time, the Dead Sea water level will gradually increase and come back to where it was some 30-40 years ago.
This alternative also means that for the Israelis, they should considerably decrease their water consumption from the Tiberias Lake, which recharges the Dead Sea. Israel, in this case, should try to find some other alternatives to have water, which include building desalination plants on the Mediterranean Sea (which is already done, though environmentally unfriendly), using treated wastewater (which is also done), or bringing water from neighboring countries, such as Turkey (discussed below). Jordan can also use the same alternatives, in addition to the possibility of extraction water from the Disi Basin (as explained above). According to Ha’aretz (2007), “Jordan is considering a cheaper, quicker alternative to a planned canal that is designed to provide Amman with drinking water.” This Jordanian initiative includes building a desalination plant on the Gulf of Aqaba and pumping the desalinated water through pipes to Amman. That solution, however, would not resolve the Dead Sea’s dwindling size problem. The Palestinians, on the other hand, must stick with their demands of getting back their rightful water resources. This, however, should not prevent them from treating their wastewater and reusing it for agricultural and industrial purposes, such as the stone industry which is considered a primary source for the Palestinian economy.

Presently, the Dead Sea situation is badly deteriorating, as it has been gradually receiving less fresh water and more wastewater. “By diverting fresh water from the Jordan River tributaries and replacing it with sewage, not only has the Dead Sea been devastated but also the culturally and historically important Jordan River has been turned into little more than an open sewage channel,” FoUME said (Aljazeera.net, 2008). The huge amounts of wastewater and sewage coming from Israel, Jordan and PAT (including Palestinian communities and Jewish settlements) end, unfortunately, in the Dead Sea.

**Mediterranean Sea-Dead Sea Alignments (Canals)**

These are five different alignments, including the ‘Southern Alignment’ – the one which was selected in the 1980s (Beyth, 2007; MedDead.org, 2008) (see Fig. (15)).
Technically speaking, these alignments are actually the same as the RSDSC, in terms of mixing of the less-saline water of the Mediterranean Sea with the hyper-saline water of the Dead Sea. The nature of the Dead Sea will be changed and some new minerals will be formed, as a result of the mixing process between the different waters of the Med and Dead Seas (as explained above in regard to the RSDSC Project).

In the case of the Med-Dead Canal, the Israelis would be, most likely, the only beneficiaries from it, as they would consume the water and have a full control on it. Because of this reason and other reasons as well, the Jordanians and the Egyptians, as well as the Palestinians did not support the idea of the Med-Dead Canal Project. In addition, Israel found that the Project will be very costly, as it was the only beneficiary from it. So, the Med-Dead Project was stopped in the 1980s (as discussed above).

**Water Shipping**

Israel and Turkey have agreed on a full-scale feasibility study for a proposed infrastructure corridor between the two countries. The plan called for a series of under-sea pipelines that would carry water, natural gas, crude oil, and electricity from Ceyhan on the Turkey’s south-eastern Mediterranean coast to Haifa in northern Israel (GWI, 2007) (see Fig. (16)).

For Israel, the water shipping deal was to fulfill its need for more water and, at the same time, to cement its relations with an important Muslim ally (Turkey). For Turkey, it was a step forward to boost its position as a regional power in the Middle East, and to enhance the possibility of becoming a member in the European Union (EU).

**Figure 15:**
Map showing the Med-Dead alternative canals and the presently proposed RSDS Conveyance (after: http://www1.american.edu/ted/images/canal.jpg).
The feasibility study of this Project, with a projected cost of US$ 30 million, was agreed upon, at high-level talks held in October 2007 in Ankara, Turkey, between Israel’s National Infrastructure Minister Benjamin Ben-Eliezer and Turkish Energy Minister Hilmi Guler. Under the proposal, the water pipeline (460 km long) would be built for transporting a minimum of 1.1 MCM/d (about 400 MCM/yr) and up to 2.75 MCM/d (about 1 BCM/yr) of fresh water from Turkey to Israel.

However, the agreement was put on hold because high oil prices made it impractical to ship the water in large tankers, as the Israeli Foreign Ministry’s spokesman, Mark Regev, said in 2006 (People Daily, 2006). Regev also said that the two countries would continue looking at other options, including building a water pipeline. Accordingly, the governments of both countries (Israel and Turkey) have suspended what was meant to be a breakthrough deal, which is shipping water in huge tankers from Turkey to the parched Holy Land.

Both governments of Israel and Turkey concluded that the deal is not feasible, but hoped to revive it in the future. “The price of the water is the crucial factor, and if it does not compete with the cost of seawater desalination, then we will not proceed with that element of the corridor,” a senior Israeli official involved in the talks said, as the basis for cost comparison was around US$ 0.60/m³ (GWI, 2007).

Figure 16: Map showing the water-shipping alternative from Turkey to Israel, and the Israeli National Water Carrier (NWC) which transfers water from the Tiberias Lake to the Israeli coastal cities on the Mediterranean Sea (after Raz, 2007).
Sustainable Jordan River Management

The Jordan River – considered a holy place for Christianity, Islam and Judaism – is one of the world’s 100 most endangered sites according to the ‘World Monument Fund’ (Lugar, 2007). As an alternative to the RSDSC Project, environmentalists, seismologists, geologists, and other scientists propose restoring and rehabilitating the Jordan River. FoEME (2007) suggested another option altogether, known as the ‘Jordan River Alternative’. This alternative helps: 1) avoid the degradation of the Dead Sea environment; 2) contribute to equal and mutual relations amongst neighbors; and 3) encourage peace in the region.

This initiative involves changing the nature of agriculture in the region, focusing on crops with low water consumption, educating populations to use water more effectively, encouraging more realistic water pricing, and exploiting other water resources, such as desalinization of saltwater and recycling of wastewater. This would bring water back into the Jordan River, and so into the Dead Sea. According to FoEME (2007) and Dan Zaslavsky, a former Israeli water commissioner, as reported by Aljazeera.net (2008), regenerating the flow of the Jordan River to bring water to the Dead Sea will cost no more than US$ 800 million, substantially much less than the huge cost estimated for the RSDSC Project.

CONCLUSIONS AND RECOMMENDATIONS

The Dead Sea, as the lowest point on Earth and as a unique environment of flora and fauna, is becoming smaller and smaller by declining its water level of about one meter per year, in average. The solution for this problem, as suggested by the three beneficiary parties (Jordan, Israel and the Palestinian National Authority) and facilitated by the World Bank, is to transfer annually about two billion cubic meter (2 BCM/yr) of saline water from the Red Sea to the Dead Sea through a conveyance (RSDSC) of about 180-200 km long.

Based on the facts that such a proposed project (the RSDSC Project) is believed to be politically motivated, and will have several negative impacts (economically, socially, environmentally, ecologically, limnologically,
seismologically, geologically, archaeologically, demographically, politically, geopolitically, water-wise, weather- and climate-wise, tourism-wise, health-wise, waste-wise, landscape-wise, biodiversity-wise, etc.), which are much more in number and much stronger in effect than the positive ones (economy boost, availability of more water, power generation, and reverse of Dead Sea damage), it is believed that implementation of the Project and its associated sub-projects (construction of desalination plant(s) and hydropower facilities) will be more damaging than rewarding and, thus, the Project should not be encouraged or supported. Hence, policy makers should rethink about other alternatives.

As an alternative to the Project, it is suggested that Nature is to take its course, by leaving the Dead Sea as is and, at the same time, by putting pressure, by the international community, on Israel to change its water-consumption policies and habits in the region. This can be simply done by gradually reducing Israel’s water consumption from the Jordan River and the Tiberias Lake. By doing so, the Dead Sea water level will gradually and naturally come back to where it was some 30-40 years ago. This can be achieved by taking into account the big fact that the declines in the Dead Sea water level and surface area and in the Jordan River flow are anthropogenic (man-made) problems.

Having said that, the RSDSC Project’s Feasibility Study (FS) and Environmental-Social Assessment (ESA) Study (both are supposed to be finished by August 2010, facilitated by the World Bank, undertaken by some Western private companies, and subcontracted by a few local institutions in Jordan, Israel and the Palestinian Authority Territories), are strongly encouraged because of their importance. This is despite the fact that the cost of these studies (about US$ 10-15 million) is really high. These studies should be carried out and completed on time, with the full support of governmental, non-governmental, academic, industrial and other institutions, which are directly or indirectly involved, as well as with the involvement of the public. The studies should be carried out in a transparent, scientific, and objective manner, without being influenced by any political or otherwise parties, institutions or organizations involved or not involved in the Project. Some environmentalists and water experts
argue that the assessment of the Project should be performed, not by representatives of the three governments, who are already in favor of the Project, but by independent international consultants. In this regard, Gidon Bromberg (Israel’s Director of FoEME) told the Jewish Review, “It’s like asking a cat to guard a bowl of milk,” (Kraft, 2009).

Nevertheless, if a decision is to be taken in favor of the planning and construction of the RSDSC Project or even of a pilot project (as recently reported in the news), it is essential that the long-term evolution and characterization of the ‘renewed’ Dead Sea should be studied, and the anticipated changes should be thoroughly investigated and examined. In addition, plans to face due risks (anticipated and otherwise) should be developed in advance. Furthermore, all conditions and recommendations should be taken into account, in order to, at least, minimize the negative impacts of the RSDSC Project on the environment, biodiversity, native population, groundwater, climate, geological setting, etc. This can only be achieved through a thorough understanding of the expected changes, in view of the negative impacts of the Project, which are investigated in this study (as discussed earlier). By taking this into consideration, the following recommendations are suggested:

1. The Palestinians should be treated as a full and equal partner at all levels and in all stages of the Project, meaning that, among other things, they should have full freedom to reach the Dead Sea shores.

2. Any amount of water that would be allocated to the Palestinians from the Conveyance’s desalinated water should not be at the expense of their rightful shares in their rightful water resources, including the Jordan River, the Tiberias Lake, the Mountain Aquifer System underlying the Occupied Palestinian West Bank, and the Dead Sea.

3. Palestinians should get their equal and full share of the electricity that will be generated from the RSDSC Project.

4. Palestinian refugees, if to be settled in the Jordan Valley and the Dead Sea-Wadi Araba area, should not be forced to relocate but, instead, to be given full freedom to choose and decide. In case that they may choose to relocate in these areas, they should be given first opportunity
to benefit from any increased tourism, construction work, and other businesses in the region.

5. Relocation of Palestinian refugees, if settled in the RSDSC Project area, should not exculpate Israel from the Palestinian refugees’ ‘Right-to-Return’ and compensation, as stated in the United Nations’ resolutions.

6. For any form of development in the region, steps should be taken to minimize or restrict the importation of the decadent culture that embodies gambling, bars, and clubs that cater to certain Western tastes, which are not commensurate with the values and cultures of the native population in the region, whose way of life should be given special attention, full respect, and high consideration.

7. Priority in employment in the construction of the Conveyance and its components (desalinization plants and hydropower facilities), if to be undertaken, and in their production and maintenance stages should be given to local communities on both sides of the site of the Project.

Finally, it is noteworthy to mention that mega projects, such as the RSDSC Project, are very controversial among scientists, politicians, and entrepreneurs, as thoroughly and comprehensively investigated and analyzed in this study. These are two examples of different points of view on the Israeli side: “These canal ideas [such as the RSDSC Project] are wasteful, inefficient, dangerous, and ridiculous,” as academician Dan Zaslavsky, professor at the Technion Institute, Haifa, said (Hersh, 2005). “This [the RSDSC Project] is potentially the perfect project, it’s all win–win–win,” as politician and businessman June Dilevsky, Financial Consultant for Israel’s Ministry for Regional Planning, said (Hersh, 2005).

Following the well-known proverb that, “One picture is better than one thousand words,” the Author preferred, however, to end this comprehensive study with, not only one picture, but with three beautiful pictures of the marvelous Dead Sea (see Fig. (17)).
Figure 17: Marvelous pictures of the Dead Sea (after Exodus, 2007; GreenProphet, 2009c; and AAGT, 2009).

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The Author wishes to express his sincere thanks to the reviewers of this study for their critical comments and suggestions.

ABBREVIATIONS

(Used in both of the text and bibliography of this study.)

AAGT Ayoun Al Reem General Trading
ACRI Association for Civil Rights in Israel
AIDS Acquired Immune Deficiency Syndrome
AIES Arava [Araba] Institute for Environmental Studies
AIP American Institute of Physics
ASCE American Society of Civil Engineers
BIC Bank Information Center
Special Themes

CEB  Coyne et Bellier
CRS  Congressional Research Service
DAS  Disi Aquifer System
DESIRE  Dead Sea Integrated Research
DSP  Dead Sea Project
DSTF  Dead Sea Transform Fault
DWCP  Disi Water Conveyance Project
ERM  Environmental Resources Management
ESA  Environmental-Social Assessment
EU  European Union
EXACT  Executive Action Team
FAQ  Frequently Asked Questions
FoEME  Friends of the Earth – Middle East
FS  Feasibility Study
GDP  Gross Domestic Product
GFZ  German Research (Forschung) Center (Zentrum)
GIS  Geographic Information Systems
GLOWA  Global Change of the Water Cycle
GPS  Global Positioning System
GWI  Global Water Intelligence
HBF  Heinrich Boell Foundation
HIV  Human Immunodeficiency Virus
HDRL  Humanitarian Disaster Response Level
IEHS  Institute for Environment and Human Security
INCO  International [Scientific] Cooperation
IPCR I  Israel-Palestine Center for Research and Information
IRIN  International Regional Information Network
ISAC  Invasive Species Advisory Committee
JEW  Jordan Environment Watch
JIIS  Jerusalem Institute for Israel Studies
JSE  Jordan Science and Engineering
JTA  Jewish Telegraphic Agency
JVA  Jordan Valley Authority
M  Magnitude of Earthquakes
MAS  Mountain Aquifer System
MENA  Middle East and North Africa Region
MER  Middle East Report
MESF  Minimum Engineered Safety Feature
MSDSC  Mediterranean Sea – Dead Sea Company
MSL  Mean Sea Level
MSNBC  Microsoft/National Broadcasting Company
NASA  National Aeronautics Space Administration
NISC  National Invasive Species Council
NOAA  National Oceanic and Atmospheric Administration
NPR  National Public Radio
NWC  National Water Carrier
OPT  Occupied Palestinian Territories
PAT  Palestinian Authority Territories
PLO  Palestine Liberation Organization
PMC  Palestine Media Center
PNA  Palestinian National Authority
PPP  Power Point Presentation
PPS  Precise Positioning Service
PWA  Palestinian Water Authority
RSDSC  Red Sea-Dead Sea Conveyance Project
SWAAS  Shallow Wadi Araba Aquifer System
SWRO  Seawater Reverse Osmosis
TDS  Total Dissolved Solids
TED  Trade and Environment Database
ToR  Terms of Reference
UN  United Nations
UNEP  United Nations Environmental Programme
UNESCO  United Nations Educational, Scientific and Cultural Organization
UNEW  University of Newcastle-upon Tyne
UNU  United Nations University
USGS  United States Geological Survey
UTC  Universal Time Coordinates
UVB  Ultra Violet Solar Radiation of Beta Kind
WAP  Wadi Araba Project
WB  World Bank
WWF  World Wildlife Fund

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UNITS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
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<tbody>
<tr>
<td>BCM</td>
<td>billion cubic meter (volume unit)</td>
</tr>
<tr>
<td>BCM/yr</td>
<td>billion cubic meter per year (yield or capacity unit)</td>
</tr>
<tr>
<td>°C</td>
<td>degree Celsius (temperature unit)</td>
</tr>
<tr>
<td>MCM</td>
<td>million cubic meter (volume unit)</td>
</tr>
<tr>
<td>MCM/d</td>
<td>million cubic meter per day (yield or capacity unit)</td>
</tr>
<tr>
<td>MCM/yr</td>
<td>million cubic meter per year (yield or capacity unit)</td>
</tr>
<tr>
<td>MW</td>
<td>Mega Watt (power unit)</td>
</tr>
<tr>
<td>USS</td>
<td>US Dollar (currency unit)</td>
</tr>
<tr>
<td>cm/yr</td>
<td>centimeter per year (change rate in height or elevation)</td>
</tr>
<tr>
<td>g/l</td>
<td>gram per liter (salinity unit)</td>
</tr>
<tr>
<td>g/kg</td>
<td>gram per kilogram (salinity unit)</td>
</tr>
<tr>
<td>kg/l</td>
<td>kilogram/liter (density unit)</td>
</tr>
<tr>
<td>km</td>
<td>kilometer (distance unit)</td>
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<tr>
<td>km²</td>
<td>kilometer square (area unit)</td>
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<tr>
<td>km²/yr</td>
<td>km square per year (area shrinkage unit)</td>
</tr>
<tr>
<td>kwh</td>
<td>kilo-watt-hour (electricity consumption unit)</td>
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<tr>
<td>m</td>
<td>meter (length unit)</td>
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<tr>
<td>m³</td>
<td>cubic meter (volume unit)</td>
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<tr>
<td>m/yr</td>
<td>meter per year (water level drop unit)</td>
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<tr>
<td>mm</td>
<td>millimeter (length or height unit)</td>
</tr>
<tr>
<td>mm/yr</td>
<td>millimeter per year (displacement or speed unit)</td>
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