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Water for Peace in the Jordan River Watershed

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INTRODUCTION[1]

Legend has it that the headwaters of the Jordan River were originally three separate streams flowing in various directions, and quarreling constantly over which was the largest and most important. Finally, the streams invited the Lord of the Universe to judge between them. The Lord descended and seated Himself on a small hill between them which, even today, is known as *Tel Dan* or *Tel el-Kadi:* "Hill of the Judge" in both Hebrew and Arabic. "Rivers! Ye are dear to Me, all three. Hearken to My counsel: Unite together and Ye will indeed be the most important." And so the Jordan was formed.

On and off since regional water talks began in May 1992 in Vienna in the context of multi-lateral negotiations between Arabs and Israelis, the inhabitants of both banks of the River have been meeting to see if they can follow similar advice. The fact, long known by hydrologists and demographers and increasingly recognized by policymakers, is that a political solution between Israel, her Arab neighbors, and Palestinians of the West Bank and Gaza, simply cannot be reached without addressing the regional water shortage. However, since watershed planning lends itself to a regional approach, and since issues of water are also tied to other issues of security and immigration, resolving conflict over water may become the most tractable of the issues to be dealt with during regional peace negotiations, providing the opportunity for the confidence-building steps necessary to reach accord over other, more contentious issues as well.

This article suggests a process to resolve the dispute over the waters of the Jordan River watershed. The resolution process, designed for a hypothetical mediator, focuses on the 'hydro-political' relations between Israelis, Jordanians, and Palestinians on the West Bank and Gaza. In conjunction with regional peace talks and development plans, this article develops a four-step process for water basin development,

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1. The author would like to thank the United States Institute of Peace for its support during completion of this work, and Prof. John Ross for his constant guidance. Some sections of this paper were included in A. Wolf, *The Jordan River Watershed: Past Attempts at Cooperation and Lessons for the Future,* 18 Water Int'l (1993).

and explores political, management, and technical options. In addition, examples of regional cooperation-inducing projects, which may help ease regional political tensions, are presented. Examples include guidelines for agreement over the existing resource, both within the Jordan River watershed and over the Mountain Aquifer, and a large-scale project for the creation of power and water. Included are sections on:

BACKGROUND TO MIDDLE EAST HYDRO-POLITICS

A. Historical Summary

Even without a recent (1988-1991) drought, the worst in this century, the countries and territories[2] that depend on the Jordan River watershed—Israel, the West Bank, and Jordan—were all expected to exceed their annual supply of water by the mid-1990s.[3] Gazans already

2. In a region as politically volatile as the Middle East, the language one uses for subjects as seemingly innocuous as geographic locations takes on grave political implications. This article tries to steer what narrow middle road there is in usage. For example, "West Bank" is used, rather than "Occupied Territories" or "Judea and Samaria;" and the "Sea of Galilee," over "Lake Tiberius" or "Lake Kinneret." The "Green Line" refers to the armistice line which held between Israel and her neighbors between 1948 and 1967. Other place names vary among English, Hebrew, and Arabic usages.

3. Water in the Middle East: Conflict or Cooperation 3 (T. Naff and R. Matson, eds., 1984).

operate at an annual water deficit of 35 million cubic meters per year (MCM/yr.).[4] Rationing, reductions of up to 50 percent in allocations to agriculture, and irreversible damage to fragile groundwater systems and surface reservoirs are becoming increasingly common.

The problems cannot be solved unilaterally. Both water systems and immigrant populations tend to ignore the barriers of political boundaries. Almost one-third of Israel's water comes from aquifer systems which originate in the hills of the West Bank.[5] This fact, and the apparent dangers of allowing Palestinian water development upgradient, have been creeping into the political rhetoric of some Israelis who advocate retention of those disputed territories.[6] On the other hand, those who argue for a Palestinian state will have to contend with similar constraints for an even more limited water supply on the West Bank and in Gaza [see Table 1—Water Use and Availability].

TABLE 1: CURRENT WATER USE AND AVAILABILITY

Water in the region is allocated between agriculture ("Agr"), domestic use ("Dom"), and industry ("Ind"), with by far the largest share going to the former. Current water budgets and allocations are given as follows:

Entity	Water Budget/Natural Potential MCM/yr.	Percentage to AGR/DOM/IND
Israel[a]	1800/1600	73/22/5
Jordan[b]	870/870	85/10/5
West Bank	115/115	78/22/-
Gaza[c]	95/60	85/15/-

[a]Israeli natural potential of about 1600 MCM/yr. is augmented through wastewater reuse, some desalination, and, until 1991, a 200 MCM annual groundwater overdraft.

[b]Jordan's budget includes 170 MCM/yr. of planned use of fossil (non-renewable) aquifers.

[c]Gaza's budget includes an aquifer overdraft of approximately 35 MCM/yr., which is leading to serious problems of saltwater intrustion.

Sources: World Resources Institute, WORLD RESOURCES, 254-5, 330-1 (1991); Israel — T. Naff and R. Matson, eds., WATER IN THE MIDDLE EAST: CONFLICT OR COOPERATION, 29, 42 (1984), TAHAL. MASTER PLAN FOR WATER (1988); Jordan — A. Ghezawi, *Jordan's Water Resources and Their Future Potential*, JORDAN TIMES, (July 1991); West Bank and Gaza — D. Kahan. AGRICULTURE AND WATER RESOURCES IN THE WEST BANK AND GAZA (1967-1987), 22-24 (1987).

4. D. Kahan, Agriculture and Water Resources in the West Bank and Gaza (1967-1987) 22 (1987).

5. R. Nativ & A. Issar, *Problems of an Over-Developed Water System: The Israeli Case*, 13 Water Quality Bull. 4, 127 (1988).

6. *See, e.g.*, the text of the advertisement taken out in the international press by the Israeli Ministry of Agriculture in August 1990, entitled, "The Question of Water — Some Dry Facts," as well as a subsequent undated Ministry position paper on the subject. Both are reproduced as Appendix III in A. Wolf, The Impact of Scarce Water Resources on the Arab-Israeli Conflict: An Interdisciplinary Study of Water Conflict Analysis and Proposals for Conflict Resolution 356-63(1992)(unpublished Ph.D. dissertation, University of Wisconsin (Madison)).

In addition, population growth continues to add to the regional water shortage. Table 2 shows the current population of each entity, each entity's respective growth rate, and extrapolated populations for the year 2020. Table 3 projects the water needs for each entity given a number of immigration scenarios. By 2020, Jordan, which recently absorbed 300,000 refugees from the Gulf War, could face an annual water deficit of 430-730 MCM/yr. It has been estimated that an autonomous Palestinian entity on the West Bank could absorb 600,000 refugees.[7] If this were to occur in the near future, the projected water deficit of between 30-220 MCM/yr. for that region for 2020 would approximately double. The anticipated 2020 water deficit for Israel, with recent and ongoing immigration from the former Soviet Union and Ethiopia, could grow to 800 MCM/yr.—more than half the entire annual flow of the Jordan River.

TABLE 2: POPULATION PROJECTIONS

A. Current populations and growth rates (without immigration):

ENTITY	1991 POPULATION	ANNUAL GROWTH RATE	EXTRAPOLATED 2020 POPULATION
Israel	4,800,000	1.6%	8,850,000
Jordan	3,600,000	3.5%	9,760,000
West Bank	900,000	3.4%	2,370,000
Gaza	600,000	3.4%	1,580,000

B. Immigration:

- Israel anticipates an influx of 1 million additonal Soviet Jews over the next ten years.
- Jordan is absorbing 300,000 refugees from the Gulf War.
- The West Bank might absorb 600,000 Palestinian refugees in the context of "right of return."

Sources: World Resources Institute, WORLD RESOURCES (1991); Soviet immigrants from Bank of Israel, ONE MILLION IMMIGRANTS — AN ABSORPTION PROGRAM (1991); West Bank immigrants from M. Heller, A PALESTINIAN STATE: THE IMPLICATIONS FOR ISRAEL, 83-85 (1983).

TABLE 3: PROJECTED POPULATION AND WATER DEMAND

Entity	Population (millions)	Water Needs Low Demand[a] (MCM/yr.)	Water Needs High Demand[a] (MCM/yr.)	Low/High Water Deficit[b] (MCM/yr.)
Israel				
1 million immigrants:[c]				
1991	4.80	1,800	1,800	200/200
2000	6.44	2,000	2,000	400/400
2020	8.85	2,200	2,200	600/600

7. M. Heller, A Palestinian State: The Implications for Israel , 83-85 (1983).

2 million immigrants:[c]				
1991	4.80	1,800	1,800	200/200
2000	7.46	2,100	2,100	500/500
2020	10.01	2,400	2,400	800/800
Jordan				
300,000 refugees:				
1991	3.60	870	980	0/110
2000	4.91	960	1,100	90/230
2020	9.76	1,300	1,600	430/730
West Bank				
No immigration:				
1991	0.90	115	180	0/ 65
2000	1.21	120	210	5/ 95
2020	2.37	140	330	25/215
600,000 immigrants:[c]				
1991	0.90	115	180	0/ 65
2000	1.61	125	250	10/135
2020	3.67	170	460	55/345
Gaza				
1991	0.60	95	140	35/ 80
2000	0.81	100	160	40/100
2020	1.58	120	240	60/180

[a]Projections assume constant demand for agriculture, growth to come through technology; low demand assumes urban use grows at current per capita usage; high demand allows 100 cubic meters per capita for urban use.

[b]Projected deficit equals current annual natural potential minus projected demand.

[c]Assumes 1 million immigrants to Israel by 1993, 2 million by 2000; Palestinian immigration is assumed to be between 1995-2005, all to the West Bank.

The inextricable link between water and politics is nothing new to this arid and volatile Middle East region. The history of Jordan River hydro-politics has been well-covered in the literature.[8] The following chronology is a brief summary of periods of water conflict and cooperation:

1915-1926. As the Ottoman Empire crumbled, the location of water resources, particularly the headwaters of the Jordan River, helped to influence the boundaries of the French and British Mandates, which later became the borders between Israel, Lebanon, Syria, and Jordan (see Figure 1—Border Proposals 1919-47).

8. *See, e.g.*, Naff and Matson, *supra* note 3; M. Lowi, *The Politics of Water Under Conditions of Scarcity and Conflict: The Jordan River and Riparian States*, (1990)(unpublished Ph.D. dissertation), Princeton University, A. Wolf, *The Impact of Scarce Water Resources on the Arab-Israeli Conflict*, 32 Nat. Res. J. (1993).

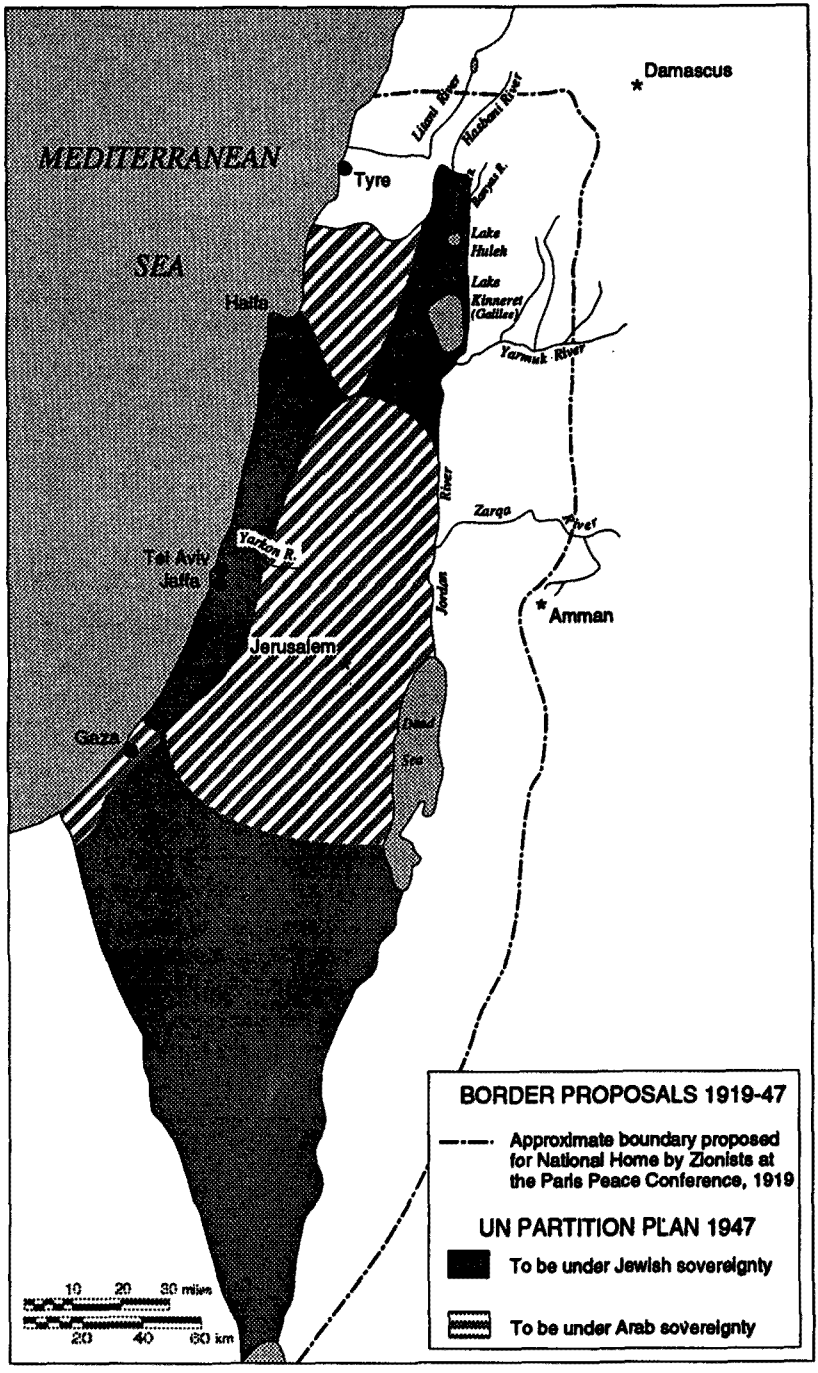
MEDITERRANEAN
SEA
Damascus
Litani River
Hasbani River
Tyre
Lake Huleh
Lake Kinneret (Galilee)
Haifa
Yarmuk River
Zarqa River
Jordan River
Tel Aviv Jaffa
Yarkon R.
Amman
Jerusalem
Gaza
Dead Sea
10 20 30 miles
20 40 60 km
BORDER PROPOSALS 1919-47
Approximate boundary proposed for National Home by Zionists at the Paris Peace Conference, 1919
UN PARTITION PLAN 1947
To be under Jewish sovereignty
To be under Arab sovereignty

FIGURE 1

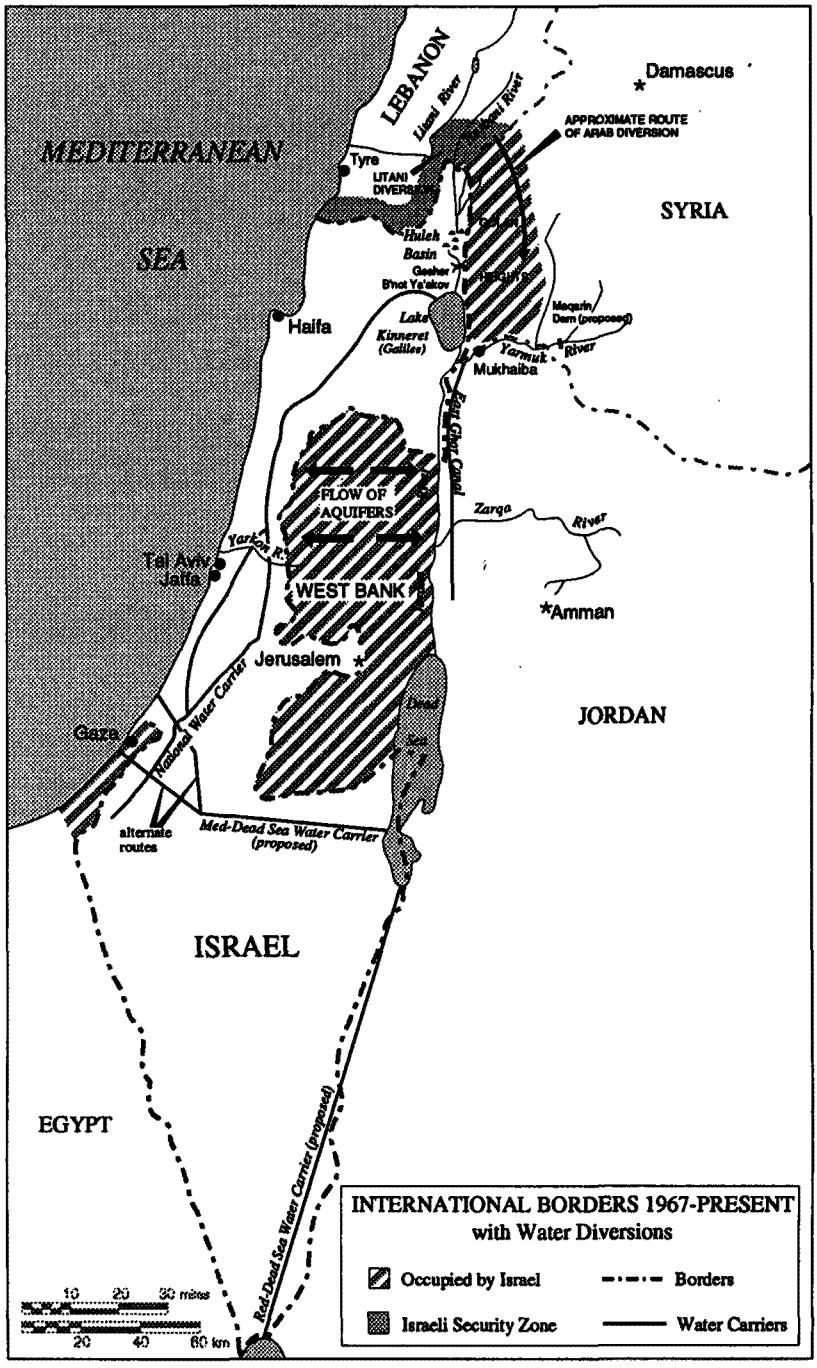
MEDITERRANEAN SEA
LEBANON
Litani River
Hasbani River
Damascus
APPROXIMATE ROUTE OF ARAB DIVERSION
Tyre
LITANI DIVERSION
SYRIA
Huleh Basin
Gesher B'not Ya'akov
Banias River
Haifa
Lake Kinneret (Galilee)
Maqarin Dam (proposed)
Yarmuk River
Mukhaiba
East Ghor Canal
FLOW OF AQUIFERS
Zarqa River
Yarkon R.
Tel Aviv Jaffa
WEST BANK
*Amman
Jerusalem
JORDAN
Dead Sea
Gaza
National Water Carrier
alternate routes
Med-Dead Sea Water Carrier (proposed)
ISRAEL
EGYPT
Red-Dead Sea Water Carrier (proposed)
10 20 30 miles
20 40 60 km
INTERNATIONAL BORDERS 1967-PRESENT
with Water Diversions
Occupied by Israel
Israeli Security Zone
Borders
Water Carriers

FIGURE 2

The 1930s-1940s. As populations and economies grew against hydrologic limits, so too grew the dangers of conflict over water. In the 1930s and 1940s, water was a focus of several reports which tried to determine the economic absorptive capacity of the land.[9] These reports influenced British, Arab, and Jewish attitudes and policies about immigration.

1948-1953. Unilateral development, occasionally infringing upon demilitarized zones.

1953-1955. Johnston Negotiations. Eric Johnston, ambassador to United States President Eisenhower, worked for two years to hammer out a water sharing agreement between the riparians of the Jordan River. The allocations to which Arab and Israeli technical committees agreed, although unratified for political reasons, have generally held, with recognized modifications. Moreover, both Israel and Jordan agreed to send technical representatives to regular "Picnic Table Talks" to determine day-to-day hydrologic operations. These talks, named for the site at the confluence of the Yarmuk and Jordan Rivers where the meetings reportedly take place, have proved fruitful over the years in reducing minor tensions.

1964-1967. "Water Wars." Beginning with the Arab decision to build an "All Arab" diversion of the Jordan headwaters to preclude the Israeli National Water Carrier, and ending three years later when Israeli tank and air strikes halted construction on the diversion, this was the period with the most direct water-related conflict.

May, 1967. Even as tensions were leading to the following week's outbreak of the Six Day War, the United States Departments of Interior and State convened an "International Conference on Water for Peace" in Washington, D.C. Six-thousand, four-hundred participants from 94 countries participated, including Israel, Egypt, Jordan, Yemen, and Saudi Arabia.

June, 1967. Six Day War changed regional riparian positioning. Israel acquired two of the three Jordan River headwaters, riparian access to the entire River, and the recharge zone for mountain aquifers which currently supply one-third of Israel's freshwater supply. Israel also destroyed the All Arab diversion scheme of the Jordan headwaters. The diversion would have reduced Israeli water supplies by 35 percent (see Figure 2—International Borders 1967-Present).

9. *See, generally,* the Esco Foundation, Palestine: A Study of Jewish, Arab, and British Policies (1947), describing the Hope Simpson Report of 1930 and the Peel Commission Report of 1937; J. Woodhead, *The Report of the Palestine Partition Commission,* 18 Int'l Affairs 2 (1939); M. Ionides. The Water Resources of the Transjordan and their Development (1939); W. Lowdermilk, Palestine, Land of Promise (1944).

May 6, 1977. Occurrence of the only ministerial-level meeting ever to take place between Jordanians and Israelis to discuss joint watershed planning.

1980s. Philip Habib helped re-negotiate the Johnston allocations based on 25 years of political and demographic changes, and tried to reach agreement about a "Unity Dam." Financing for such a dam on the Yarmuk River, long-planned by Syria and Jordan, has been held up by the World Bank until all riparians, including Israel, agree to new flows and allocations.

1990s. Richard Armitage led United States State Department indirect mediations to reach agreement about "Unity Dam."

1967-Present. Ownership and management conflicts between Israel and the West Bank, Israel and Gaza, Israel and Jordan, Jordan and Syria, and Jordan and Saudi Arabia, as explored below.[10]

Two historic themes have found favor among some authors in academic literature and popular press: the "hydraulic imperative,"[11] according to which Israel's territorial conquests have actually been quests for greater water resources and the theme of "hydro-nationalism,"[12] which postulates that Israeli water security depends on retention of the entire West Bank and Golan Heights in perpetuity. These themes describe an underlying pattern in the complicated history of hydro-politics. They are both discussed and critiqued more fully elsewhere.[13] However, since it is helpful to agree on a common history before planning for the future, the following points summarize conclusions drawn from an extensive investigation of these two themes:

(1) Water resources were not a factor for Israeli strategic planning in the hostilities of 1967, 1979, or 1982. The locations of water resources were not considered strategic (except in the purely military sense), nor were such locations a factor in retaining territory immediately after the hostilities. In the mid-1970s, however, a narrow band of the West Bank did begin to be claimed by Israel as crucial to retain for hydrologic reasons.

(2) There is no evidence that Israel is diverting any water from the Litani River, either by pipe or by truck. In fact, since 1985, when central southern Lebanon lost its own water supply, an average of

10. *See, supra* note 7.

11. *See, generally,* U. Davis, *et. al., Israel's Water Policies,* 9 J. of Palestine Stud. 2, 3 (1980); T. Stauffer, *The Price of Peace: The Spoils of War* 1 American- Arab Affairs 43 (1982); J. Cooley, *The War Over Water,* 54 Foreign Pol'y 3 (1984); J. Dillman, *Water Rights in the Occupied Territories,* 19 J. of Palestine Stud. 1, 46 (1989).

12. This theme has not found the same prevalence in the literature as the 'hydraulic imperative,' being found notably within the ministry of former Israeli Agricultural Minister Rafael Eitan A. Wolf, *supra* Note 6. Nevertheless, in order to allow for greater flexibility in negotiations, it is worth investigating the hydrologic validity of the claim.

13. *Id.*

50,000 cubic meters per month has been piped into that region from wells in northern Israel.

(3) The claim that Israel requires the entire West Bank for its water security is not hydrologically sound. Israeli technical experts and government officials have, since the mid-1970s, developed a "red line" informed by the watershed boundary and population centers, as well as by security needs, beyond which Israel could not safely withdraw even in the event of an exchange of "land for peace." This amounts to a narrow band of the most western part of the West Bank, drawn approximately along the 100 meter contour line.

B. Guidelines From History Applicable To Regional Peace Negotiations

The above sketch of regional hydro-politics offers several lessons which could be useful in helping to formulate options for solutions to water-induced tensions. Before proceeding to examine possible solutions to the Middle East water conflict, it might be helpful to consider the following lessons from history and their potential applicability to the future:

(1) Observation: The link between water resources and political alternatives is inextricable, with water scarcity leading directly to both heightened political tensions and to opportunities for cooperation.
Recommendation: For negotiations for a political settlement to be successful, they also will have to address solutions to the water conflict. Likewise, workable solutions to the problems of regional water shortage should also address the constraints posed by regional politics.

(2) Observation: Water has historically been a factor in Middle East population distribution, including some border considerations.
Recommendation: Successful negotiations over Jewish immigration or Palestinian "right of return" will have to incorporate the hydrologic limitations of the region.

(3) Observation: No dispute between Arabs and Israelis, about water or any other issue, has ever been resolved without third-party (usually United States) sponsorship and active participation.

and

(4) Observation: The better a state's "hydro-strategic" position, the less interest it has in reaching a water-sharing agreement.
Recommendation: Strong third-party involvement will be necessary for successful negotiations. The United States or other sponsors of negotiations should be prepared with a comprehensive

strategy to induce cooperation, with particular emphasis on the upstream riparians.

(5) Observation: Projects of limited and implicit cooperation have been successful even in advance of political solutions between the parties involved (*e.g.*, Picnic Table talks; water-for-peace process). Nevertheless, explicit cooperation (*e.g.*, Unity Dam) has not preceded political relations.

and

(6) Observation: The more complex a proposal is technically, the more complex it is politically.
Recommendation: In the context of regional talks, progress in negotiations over water resources may encourage dialog about other, more contentious issues. While water continues to "lead" the peace talks, projects to induce cooperation can be designed in a step-wise fashion beginning with "small and doable," and leading to ever-increasing integration, always remaining on the cutting edge of political relations.

(7) Observation: The two conditions at the core of the political viability of water sharing are *equity* of the agreement or project (that is, how much does each participant get), and *control* by each party of its own primary water sources (or, from where does the water come, and whose hand is on the tap).
Recommendation: These two contentious issues will have to be addressed fairly early in negotiations. Unless a water sharing agreement is achieved, with each party having its historic as well as future needs addressed, any negotiations over intricate cooperative projects will be building on accumulated ill-will.

If one accepts that conflict can come about in part because of scarce water resources, and understands that as populations and economies grow against hydrologic limits, the dangers grow as well, the logical question is, "What is to be done?"

There are actually two distinct problems in the Jordan River watershed. The first is a "water crisis"—too little water supply for too much demand—similar to many water basins throughout the region and the world. The second problem is the "water conflict"—the political tensions brought about by a water crisis in this particular international water basin, which is shared by riparians who have deep and long-standing enmity towards one another.

The approach taken here is to address the water crisis by formulating a water development plan for the Jordan basin. In the process, by keeping in mind the lessons of the history of this particular watershed, suggestions for alleviating some aspects of the water conflict will be offered as well.

WATER CONFLICT RESOLUTION

A. Survey Of Hydro-Political Positions

There is a vital need for a regional water development plan that incorporates the political realities of the region, the limitations imposed by economics and hydrology, and the process of conflict resolution.[14] The discussion below describes steps which might be taken toward such a plan, along with suggestions for evaluating conflicting claims. Included in the discussion is the presentation of a comprehensive desalination project involving Israelis, Palestinians, and Jordanians and/or Egyptians.

Before examining possible solutions to the water conflict, it is important to explore each actor's opening position as regional peace talks begin. The following brief, highly generalized descriptions of the actors' positions are taken from interviews with the water advisors to each delegation.[15]

Jordan

The Jordanians might put much of their emphasis on the allocations achieved during the Johnston negotiations. Although they would probably allow for some minor revisions in Israel's favor, the Jordanians point out that Jordan is currently being deprived of Yarmuk River water from both down- and upstream. Israel takes advantage of Jordan's lack of storage capacity to increase Israel's annual intake from the Yarmuk, which is currently about 90 MCM/yr., (versus 15 MCM/yr. originally allocated). Meanwhile, Syria has launched a drive to impound Yarmuk headwaters upstream from Jordan, partly with the presumed justification of depriving Israel of this water. Syria presently holds back 250 MCM/yr. and plans to withhold an additional 50 MCM/yr. Jordan hopes that by reaching an agreement with Israel, similar accord will follow with Syria. This would clear the way for both allocations to be closer to those of the Johnston negotiations (originally 337 MCM/yr.), and for a long-planned storage facility to be built at Maqarin. Jordan also hopes to reach an accord with Saudi Arabia on a program for joint exploitation of a large fossil aquifer underlying their shared border.

14. For an application of how the process of conflict resolution, as described in the alternative dispute resolution literature, might be applied to the water conflict in the Jordan River watershed, see Wolf, *supra* note 1, or, more generally, to international water conflicts, see J. Delli Priscoli, *Collaboration, Participation and Alternative Dispute Resolution: Process Concepts for the (World) Bank's Role in Water Resources*, Draft, (1992).

15. A number of these interviews were conducted on the condition of anonymity at the request of the advisors. The circumstances of the interviews and each actor's position are described in somewhat more detail in Wolf, *supra* note 11.

West Bank and Gaza Palestinians

The Palestinians, not separately represented during the Johnston negotiations, might base their current claims on a combination of past promises and as yet unacknowledged groundwater rights. If the water diversions included in the Johnston negotiations had been developed, water from two new sources would have been delivered to the West Bank. Specifically, the West Ghor Canal would have brought 70-150 MCM/yr. to a narrow agricultural strip parallel to the Jordan River, in addition to up to 300 MCM/yr. designated for the Jordan Valley from the Yarmuk and the Jordan Rivers. Palestinians also claim first rights to all of the groundwater which originates in the West Bank and Gaza — about 615 MCM/yr. and 60 MCM/yr., respectively.[16] Since 1967, Palestinians have objected to Israeli measures to control development of West Bank water resources. These limitations include nationalization and integration of West Bank water with the Israeli grid, and limitation of agricultural allocations to 1967 levels.

Israel

Israeli claims combine political modifications due from the Johnston negotiations with the concept of "water security." Israel accepts the principles of the Johnston allocations, but insists on the incorporation of modifications reflecting changing geopolitics. For example, Israel claims a greater share of Yarmuk water than was originally allocated in the Johnston negotiations, on the basis of its new obligations to the West Bank since 1967, as well as by rights acquired through its historic use of what it considers to be surplus flow unexploited by the Jordanians. By the same token, Israel considers its historic rights to the Mountain Aquifer, which originates on the West Bank but which has been exploited by Israel from Israel's side of the Green Line since the 1950s, irrevocable and tied to greater issues of security. Measures taken to restrict pumping on the West Bank have been described by Israel as defensive, necessary to protect its coastal wells and the integrity of the water system as a whole. Unchecked Palestinian water development or pollution in the hills west of the watershed line, the Israelis argue, could endanger both the quantity and quality of water sources on which the heavily-populated coastal plain of Israel relies (see Figure 3—Jordan River Watershed). Israel's focus for the future might be to try to retain as many of its current sources of water as possible, and to introduce large-scale desalination projects into the region with international backing and financial assistance.

16. *See, e.g.*, H. Zarour & J. Isaac, Nature's Apportionment and the Open Market: A Promising Solution Convergence to the Arab-Israeli Water Conflict, Paper Submitted to the Conference on The Middle East Water Crisis (May 7-9, 1992).

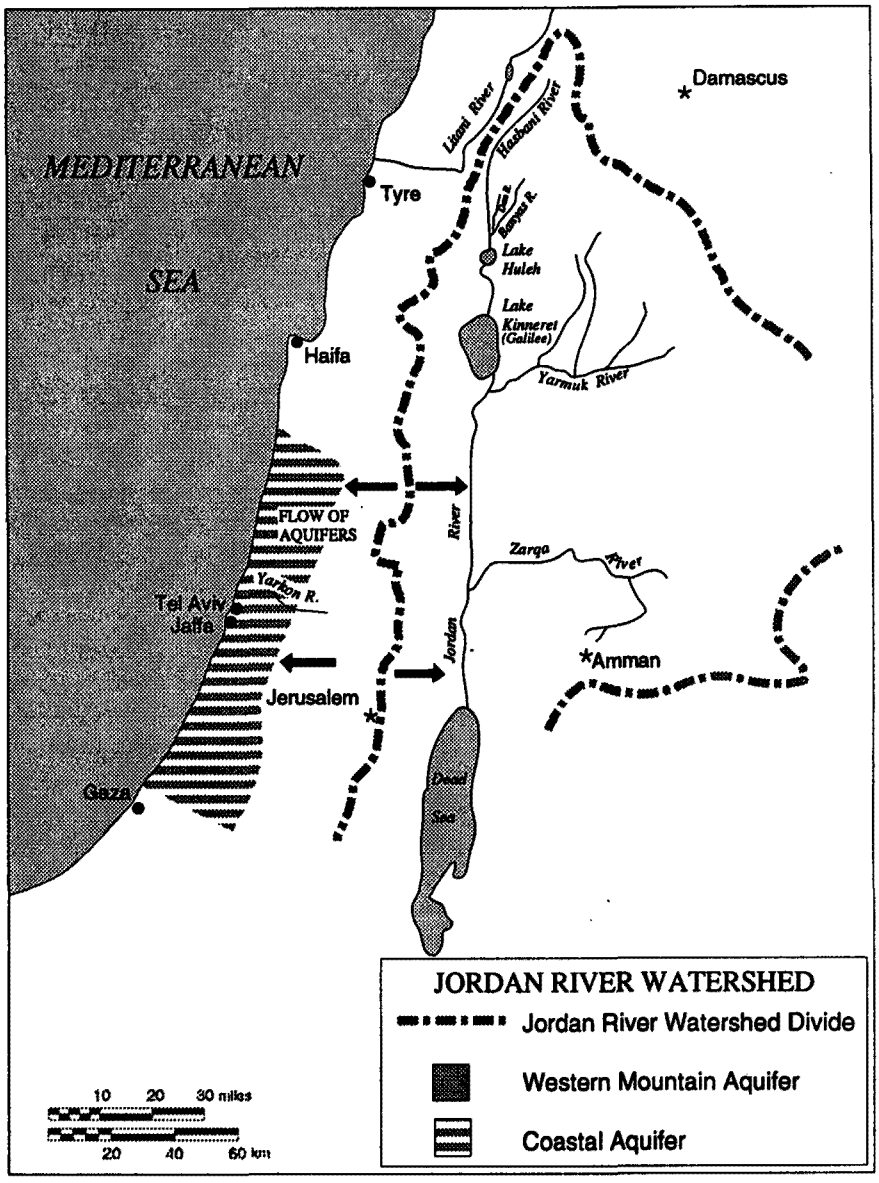
MEDITERRANEAN
SEA
Damascus
Litani River
Hasbani River
Tyre
Banyas R.
Lake Huleh
Lake Kinneret (Galilee)
Haifa
Yarmuk River
FLOW OF AQUIFERS
Jordan River
Zarqa River
Yarkon R.
Tel Aviv Jaffa
Amman
Jerusalem
Dead Sea
Gaza
JORDAN RIVER WATERSHED
Jordan River Watershed Divide
Western Mountain Aquifer
Coastal Aquifer
10 20 30 miles
20 40 60 km

FIGURE 3

The specific issues of the water conflict which have to be addressed in the context of solutions to the water crisis include:

(1) An ongoing dispute between Israel, Jordan, and Syria regarding the proposed Unity Dam on the Yarmuk River. Israel and Jordan must reach agreement on the former's share of the Yarmuk waters before funding from the World Bank, which insists that all riparian states agree to a water project, can be allocated. Jordan is also concerned with Syria's impoundment and diversion of an increasing amount of the Yarmuk's headwaters.

(2) Final determination of who will provide the West Bank with its legitimate surface water allocations from the Johnston negotiations, and from where.

(3) Israeli concerns about upgradient Palestinian groundwater development, versus Palestinian assertion of the legal right to both more of the water of the shared Mountain Aquifer than the Palestinians currently receive, and the right to greater control of the Aquifer's development. Other, lesser groundwater disputes (and opportunities for cooperation) exist between Israel and Gaza, Israel and Jordan, Jordan and Saudi Arabia, and Israel and Egypt.

TABLE 4: WATER MANAGEMENT OPTIONS TO INCREASE SUPPLY OR DECREASE DEMAND

UNILATERAL OPTIONS

DEMAND

- Population control.
- Rationing.
- Public awareness.
- Allow price of water to reflect true costs (including national water markets).
- Efficient agriculture, including:
  - Drip irrigation
  - Greenhouse technology
  - Genetic engineering for drought and salinity resistance

SUPPLY

- Wastewater reclamation.
- Increase catchment and storage (including artificial groundwater recharge).
- Cloud seeding.
- Desalination.
- Fossil aquifer development.

COOPERATIVE OPTIONS

- Shared information and technology.
- International water markets to increase distributive efficiency.
- Interbasin water transfers.
- Joint regional planning.

B. Recommendations

Table 4 lists each of the technical and policy options available to the Jordan River watershed to increase water supply or to decrease demand. By ranking each of the options by the technical (including environmental), economic, and political viability, a plan can be developed, both to overcome projected deficits in the water budget, and, in the process, to help alleviate water related political pressures. Lessons from the region's history of hydro-politics can be incorporated in the planning to increase cooperation and integration as political relations develop. The general guidelines for such a plan might include:

(1) 'Dis-integrating' the control of water resources to address past and present grievances. Many plans for water development in the Jordan River watershed incorporate the premise that increased integration of institutions or water projects is an impetus to greater political stability.[17] While the advisability of striving towards ever-increasing integration is recognized, as is the fact that, "lasting peace among nations is characterized by a broadly based network of relations,"[18] it is nevertheless suggested that for resource conflicts in general and for water conflicts in particular, first it should be ensured that each entity has adequate control of an equitable portion of its primary resource. Past and present grievances need to be addressed before embarking on projects of cooperation or integration.

Because much of the past conflict over water has concerned ambiguous water rights, any attempt at cooperative projects preceding the clarification of these rights will be building on years of accumulated ill-will. The clear establishment of property rights is also a prerequisite for any market solutions, such as water banks or markets, which might be applied. Furthermore, as mentioned previously, the political viability of international planning or projects depends on each entity agreeing on the equity of the project (who gets how much), and on control of the resource (who exercises control, and from where). The necessary steps include:

— Negotiating property rights to existing resources;

17. *See, e.g.*, the proposals of E. Kally, *The Potential for Cooperation in Water Projects in the Middle East at Peace, in* Economic Cooperation in the Middle East 325 (G. Fishelson, ed., 1989). Kally contends that, "the successful implementation of cooperative projects . . . will strengthen and stabilize peace" *Id.* at 325. This concept of inducing increasing integration even between actors with some hostility towards each other is also a strategy employed in the United States by the U.S. Army Corps of Engineers, and recommended for international settings by Corps representatives.

18. H. Ben-Shahar, *Economic Cooperation in the Middle East: From Dream to Reality in* Kally, *supra* note 15.

— Guaranteeing control of a water source adequate to meet future needs; and

— Addressing the issue of equity within the design of any cooperative project.

Since these steps involve a separation of control as a precondition to "integration," this process might be referred to as "dis-integration."

(2) Examining the details of initial positions for options to induce cooperation. Each party to negotiations usually has its own interests foremost in mind. The initial claims, or "starting points" in the language of Alternative Dispute Resolution (ADR), often seek to maximize those interests. By closely examining the assumptions and beliefs behind the starting points, one might be able to glean clues about how to induce some movement within the "bargaining mix," or range within which bargaining can take place, for each party. These underlying assumptions and beliefs may also point toward the creative solutions necessary to move from distributive bargaining ("win-lose") over the amount of water each entity should receive, to integrative bargaining ("win-win"), i.e., inventing options for mutual gain.

(3) Designing a plan or project, starting with small-scale implicit cooperation, and building towards ever-increasing integration, always "leading" political relations. Building on the first two steps, riparians of a watershed who have clear water rights and control of enough water for their immediate needs, might begin to work slowly towards increasing cooperation on projects or planning. Even hostile riparians, it has been shown, can cooperate if the scale is small and the cooperation is secret.[19] Building on that small-scale cooperation, and keeping the concerns of equity and control firmly in mind, projects might be developed to increase integration within the watershed, or even between watersheds over time.

The design of a plan or project can incorporate a feedback loop to allow for greater cooperation as political relations develop, encouraging the project always to remain on the cutting edge of political relations. A process for ongoing conflict resolution would also help relieve tensions which might arise due to fluctuations in the natural system. This process of "cooperation-inducing-design" can be applied to water rights negotiations, to watershed planning, or to cooperative projects for watershed development, as will be explored below.

C. A Four-Stage Process For "Water-For-Peace"

Given the guidelines for "cooperation-inducing-design" as described above, one might group the technical and policy options available to the watershed in a general four-stage process for water basin

19. *See supra* note and accompanying text.

development.[20] The initial emphasis would be on unilateral projects, with increasing cooperation and integration as political relations develop. Allowing for some overlap, the four stages of water basin development are: 1) negotiate an equitable division of existing resources; 2) invest in greater efficiency for water supply and demand; 3) alleviate short-term needs through water imports, if available and politically viable; and 4) develop a regional desalination project in cooperation-inducing stages.

(1) Negotiate an Equitable Division of Existing Resources.

Each of the parties to Middle East regional peace talks already has water development high on its list of priorities for negotiations. Different approaches and emphases for the future indicate that the first stage in cooperation is to settle past grievances about allocations of existing resources. Because the overwhelming shortage is region-wide, this exercise would admittedly address political needs more than those of hydrology. Nevertheless, each party's perceptions of water priorities are crucial to determining the direction of future development, and the overall issue of control of one's resources can take on the importance of control of one's national destiny. Palestinians and Jordanians should not have cause to feel that Israeli lawns or swimming pools come at the expense of their own agriculture. Similarly, Israelis should not have cause to watch Palestinian or Jordanian upstream development projects with trepidation. It would seem, after 70 years of contested water rights, that this issue would have to be resolved before any of these hostile parties could be induced to cooperate on regional projects.

In addition to addressing past and present grievances, legal allocations should define each riparian's water resource property rights. This is an important prerequisite to using the market-oriented tools of economics to help increase efficiency in supply and demand. Water markets cannot be created either nationally or internationally until clear water rights have been established.[21]

(2) Invest in Greater Efficiency for Water Supply and Demand.

After it is clear who has rights to what water, but before developing intricate and expensive projects for new water supplies, a great return can be achieved simply by investing in the existing system of water supply and demand. Options for increasing efficiency may be attempted either unilaterally, by each country and territory in-

20. Both the ranking process and the four stages are described in more detail in Wolf, *supra* note 11.

21. Suggestions for how an agreement for water-sharing might be reached are offered later in this paper. *See* section entitled, "Towards an Agreement for Sharing Existing Resources," *infra* p. 27.

volved, or regionally, with cooperation among the entities in the area. In fact, the scarcity of a resource as critical to economic and physical survival as water may induce cooperation over regional issues in addition to water in the context of peace negotiations.

a. Unilateral efforts

Israel, Jordan, the West Bank, and Gaza already encourage very efficient farm practices such as drip and computerized irrigation, and each is pursuing policies for wastewater reclamation. However, the water shortage is so severe that more extreme solutions, such as extensive pipelines or buying water by the bargeload from Turkey, are being explored. Drastic institutional steps, like moving water away from agriculture and into the industrial sector, are being undertaken, but these measures clash with national ideologies and entrenched water institutions of nations built around the mystique of the *fellah* and the *kibbutznik*. A recent Israeli State Comptroller's report,[22] for instance, blamed an annual overdraft of water resources in that country in part on the historically close relations between Israel's agricultural sector and the Water Commissioner, who is responsible for allocating the nation's water. Water scarcity is not likely to change immigration population control policies for similar ideological reasons.

In any event, unilateral measures can add only incrementally to alleviation of the water shortage problem for any of the entities involved. Nevertheless, what savings can be achieved through unilateral steps ought to be pursued as political relations are developing. Some policy recommendations that might be considered include:

— Increased economic efficiency through shifts in water use from agricultural to industrial sectors. Although some recommend a shift of as much as 35 to 40 percent,[23] it should be remembered that the states involved have security and ideological concerns that may preclude the states from becoming major food importers, even if it is more economical to do so. These concerns should be weighed when determining how much of a shift is warranted.

— Increased support for research and development of water-saving technology. This could include small-scale applications, such as low-flow shower nozzles and toilets, and larger-scale projects, like sequential re-use and wastewater treatment, for the agricultural and industrial sectors. The Unity Dam finally might be built as well, if political relations allow. Special emphasis could be placed on desalination technology, again both small- and large-scale.

Some options for immediate emphasis might include:

22. State of Israel, State Comptroller, Report on Water Management in Israel (1990).

23. *See, e.g.*, T. Naff, *Hydropolitics in the Middle East: Opportunities for Fresh Thinking about Old Situations*, presented at the Conference on Water Quantity/Quality Disputes and their Resolution(May 1992).

(i) Wastewater reclamation at all the urban centers. This would allow greater allocations to agriculture and provide, by exchange, better quality drinking water for personal use.

(ii) Investment in water-efficient agriculture, including drip irrigation and the necessary pressurized delivery system; greenhouse technology; and genetic engineering for drought- and salinity-resistant crops.

(iii) Overhaul of the current water delivery systems to prevent leakage and excessive evaporation.

(iv) Reduction of price controls. The price of water could be allowed to rise to reflect the actual cost of delivery and treatment. This step, already planned for most of the region, would help reduce the economic appeal of inefficient agriculture, and also would make alternative supply sources more attractive economically.

b. Shared information and research

The most tractable opportunity for cooperation over water is for the entities on both sides of the Jordan River to share what information they have and to develop joint research strategies for the future. Regional water resource planning on, at a minimum, the watershed scale, should be encouraged. In the case of the Jordan River, representatives from Lebanon, Syria, Jordan, Israel, and the West Bank could work together, as political developments allow, on watershed management planning. For greater efficiency, the geographic scale of planning could be increased. Planning options multiply as the scale considered and the sources of water resources increase. Allowances should be made for changes in climate and demographics, as well as for increasing understanding of the physical system.

Some exchange of information could take place even in advance of formal diplomatic relations. In May 1967, even as tensions were leading to the following week's outbreak of the Six Day War, the United States Departments of Interior and State convened an "International Conference on Water Peace" in Washington, D.C. Six-thousand, four-hundred participants from 94 countries, including Israel, Egypt, Jordan, Yemen, and Saudi Arabia participated.[24]

As national water demand approaches the limit of supply throughout the Middle East and, in fact, the world, similar forums for dialog could be emphasized. Israeli and Arab expertise in water-saving agricultural practices, wastewater reclamation, and desalination technology should be exchanged and jointly developed. A 1987 study sponsored by the Center for Strategic and International Studies called

24. United States Departments of Interior and State, Water for Peace, Proceedings from the International Conference on Water for Peace, Washington, D.C. (May 23-31, 1967).

for a United States -sponsored project to promote joint data collection and technology development.[25] Clearly, arid areas of the United States would also benefit from such a project. Both Starr[26] and Kolars[27] describe the establishment of centers for water data sharing and gathering as a means of promoting cooperation.

In May 1992, the first round of multi-lateral negotiations on water was held as part of the regional peace process begun in Madrid, Spain. Representatives from 20 countries attended, and each party agreed to compile a program for regional development. These programs will be examined in the United States for any commonalties which could be exploited to induce cooperation. Creative third-party assistance and influence will be necessary to help the process overcome the obstacles which undoubtedly will be encountered.

(3) Alleviate Short-Term Needs through Interbasin Water Transfers

Along with information and technology, water itself might be moved across borders for mutual benefit. Interbasin water transfers to the Middle East region have been considered since at least the turn of this century and many of these ideas are enjoying renewed interest. Immediate surpluses could be exploited as a stop-gap measure while more elaborate water transfer projects are being established. Short-term surpluses are currently available in the Litani River and Nile River systems and, further afield, from several rivers in Turkey, including the Seyhan, Ceyhan, and Goksu Rivers.

Kally[28] has suggested a variety of projects for interbasin transfers which, he argues, would be of region-wide benefit. One possibility suggested by Kally is to store Yarmuk River winter run-off in the Sea of Galilee for use in Jordan, and possibly the West Bank, during the summer.[29] This would save Jordan and Syria the expense of constructing the Unity Dam on the Yarmuk and, at the same time, would help sweeten the somewhat saline water of the Sea of Galilee for Israeli use. Other possibilities include transferring excess surface water from the Nile River to Gaza and from the Litani River to the West Bank. This would alleviate desperate water shortages without endangering Israeli groundwater supplies. Another option, on a slightly larger scale,

25. J. Starr & D. Stoll, U. S. Foreign Policy on Water Resources in the Middle East 44 (1987).

26. J. Starr, *Middle East Water Security Framework: Historic Opportunity for Regional Stability and Sustainable Development*, presented at the Conference on Middle East Water at the Council on Foreign Relations(June 1992).

27. J. Kolars, *The Role of Geographic Information Systems (GIS) Technology in the Future Management of Middle Eastern Rivers*, presented at the 1991 Middle East Studies Association Annual Meeting (November 12-26, 1991).

28. Kally, *supra* note 15, at 303.

29. *Id.* at 307.

is the proposed Turkish "Peace Pipeline," a $20 billion project to bring freshwater to parched states as far south as the Arabian Peninsula.[30]

One arrangement was developed by Jordan after the extensive Johnston negotiations (1953-55). In the context of its own national water diversions along the East Ghor, 70-150 MCM/yr. of water were allocated to the West Bank, at the time an integral part Jordan. A siphon was planned, but never built, to move water from the East Ghor Canal for this purpose. Although modern Jordan has its own water problems, it still "owes" this water to the West Bank. This surface water would increase the West Bank water budget by more than 60 percent and negate the dangers to Israel of unchecked groundwater development on the West Bank. Jordan more recently has made preliminary investigations into the possibility of importing Euphrates River water from Iraq for Jordan's use.

The most viable water transfer options for the near future include:

(i) Diverting the Litani River into the Sea of Galilee, from where it could go to Israel, the West Bank, and/or Jordan. A pipeline along the Mediterranean coast might bring water from the mouth of the Litani as far as Gaza. If a conventional energy plant were built in Lebanon in the context of regional development, Lebanon might be persuaded to allow more Litani River water through the Qur'awn Dam, where most of the Litani is currently diverted to the Awali watershed for hydropower generation. Costs might be reduced by using existing infrastructure. For example, the TAPline, an abandoned oil pipeline, runs from the Litani, up over the Golan Heights (where a section is currently being used for water delivery), and as far as the Persian Gulf.

To date, Lebanon's position has been that the rights to Lebanese water should be retained for Lebanese use. If that were to change, the Litani is poised to be beneficial to any number of regions.

(ii) Extending the El-Arish pipeline from the Nile River to Gaza or the Negev Desert. This would allow the same exchanges throughout the region as the addition of Litani water. Increased water in southern Israel, for example, would free up water from the northern Jordan River to be delivered to Jordan or the West Bank. Although Sudan and Ethiopia may have legal rights to a say in any out-of-basin transfer, an exchange of water-saving technology for water between Israel and Egypt may reduce those claims and allow Egypt to export water farther into the future.[31]

30. C. Duna, *Turkey's Peace Pipeline, in* The Politics of Scarcity: Water in the Middle East 119 (J. Starr and D. Stoll, eds., 1988).

31. A. Dinar & A. Wolf, *International Markets for Water and the Potential for Regional Cooperation: The Case of the Western Middle East, in* Sharing Scarce Fresh Water Resources in the Mediterranean Basin: An Economic Perspective (M. Shechter, ed., forthcoming 1993).

(iii) Importing water from Turkey. Turkey, the only country in the region with a substantial water surplus, is invariably named as a possible source from which to import water. Along with the "Peace Pipeline" described above, several smaller projects have been proposed to bring Turkish water to any of a number of states in the area by pipeline, by barge, or in million-cubic-meter "Medusa Bags." Another proposal, forwarded by Wachtel,[32] is to pipe water from the Ataturk Baraji Lake from the Turkish GAP project, to the Golan Heights. Here, an open channel would combine new freshwater supplies and hydropower for Israel, Syria, Jordan, and the West Bank, as well as act as an anti-tank barricade on the border between Israel and Syria. Wachtel estimates that the cost of such a project would be $5-7 billion.[33]

Again, once additional water becomes available, the appropriate exchanges could be made from sources to users, and the most efficient regional distribution would be achieved. However, because surpluses are extremely tenuous in terms of both engineering and political viability, these new sources should be considered short-term only.

(4) Create Large-Scale Regional Desalination Projects

Desalination projects have often been looked to for a quick fix to regional water scarcity in the Middle East. Any large-scale desalination projects, however, will have to pass the difficult triple test of technical (including environmental), economic, and political viability. Past attempts at large-scale water projects, both unilateral and cooperative, may provide useful clues to guide successful implementation in the future. Two such projects, the Agro-Industrial Complex, a United States -supported cooperative project for the Middle East studied in the 1960s, and the Mediterranean to Dead Sea Hydro-Electric Canal (hereinafter, the "Med-Dead Canal"), an Israeli project studied in the 1980s, serve as useful models. The best aspects of the two projects—the regional approach and emphasis of the Agro-Industrial Complex on international cooperation, and the focus on comparatively safe energy applications of the Med-Dead Canal—could be combined and expanded for a new hybrid water and power project for the 1990s. This project, in turn, could be incorporated into a badly needed regional water development plan for the Middle East. Such a project is discussed in the next section as an example of the potential of "cooperation-inducing-design."

32. B. Wachtel, *The Peace Canal Project: A Multiple Conflict Resolution Perspective for the Middle East*, (1992)(manuscript on file with author).

33. *Id.*

COOPERATION-INDUCING IMPLEMENTATION: THREE EXAMPLES

Given the vital need for a regional water development plan that incorporates the political realities of the region as well as the limitations imposed by economics and hydrology, possible steps which might be taken are described above in the four-stage process for regional water development.[34] Even if the riparians to the Jordan River watershed were to agree to this four-stage process, only the regional water crisis, i.e., the lack of water in the basin for anticipated needs, would be addressed. The water conflict, i.e., the political tensions attendant to the lack of water, would remain.

A recently developed sub-field of ADR, "dispute systems design," is a process of integrating the potential for ADR into public institutions and other organizations that deal with conflict. Described by Ury *et al.*,[35] dispute systems design may offer lessons about enhancing cooperation in water systems as well. Although most of the work in this field describes the incorporation of cooperation-inducement into organizations, some of the same lessons for "enhancing cooperation capacity,"[36] or "design considerations"[37] and "design guidelines,"[38] might be applicable to technical or policy systems as well. A water-sharing agreement, or even a regional water development project, for example, might be designed from the beginning specifically to induce ever-increasing cooperation by steady increments, as the project incorporates ever-increasing integration.

The preceding survey of history[39] suggests that cooperation-inducing strategies might be incorporated into the process of implementation as well. This section offers three examples of "cooperation-inducing implementation." General guidelines, as described earlier,[40] include the following:

(i) Control of one's major water sources is of primary concern to each of the riparian entities, and is necessary both to address past and present grievances, and as a prerequisite for market-driven solutions. As such, an initial "dis-integration" of the water sources of the basin is recommended.

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34. *See* text *supra* at note 19.

35. W. Ury, J. Brett, & S. Goldberg, Getting Disputes Resolved: Designing Systems to Cut the Costs of Conflict (1988).

36. D. Kolb & S. Silbey, *Enhancing the Capacity of Organizations to Deal with Disputes*, 6 Negotiation J. 300 (1990).

37. D. O'Connor, *The Design of Self-Supporting Dispute Resolution Programs*, 8 Negotiation J. 87 (1992).

38. M. McKinney, *Designing a Dispute Resolution System for Water Policy and Management.*, 8 Negotiation J. 160 (1992).

39. *See* text *supra* at note 22.

40. *See* text *supra* at note 13.

(ii) Opportunities for cooperation may be hidden in the details of each entity's bargaining mix, i.e., the range within which bargaining can take place.

(iii) Water basin development can then proceed from "small and doable" projects to ever-increasing cooperation and integration, remaining always on the cutting edge of political relations.

A viable agreement should also incorporate mechanisms for any future misunderstandings to be resolved. The circumstances that bring about a conflict are seldom static, and neither are the conditions of agreement. This is particularly true for hydrologic conflicts, where supply, demand, and understanding of existing conditions all change from season to season, and from year to year. Crisis management for droughts, floods, and technical (*e.g.* dam or sewage facility) failures are other variables that must be addressed in this context.

The examples of cooperation-inducing implementation presented below are taken from throughout the four stages of basin development already described. The first example describes guidelines for reaching a basin-wide agreement for sharing the existing water resources of the Jordan River watershed. The second focuses on the groundwater resources of the Mountain Aquifer shared between Israelis and Palestinians, and discusses the potential for cooperative groundwater development. The third and final example describes the potential for a cooperation-inducing regional desalination project based around a Med-Dead or a Red-Dead canal.

A. Towards An Agreement For Sharing Existing Resources

The first stage of the four-stage process for water basin development is the need for an agreement on allocation of the existing resource. This is described as necessary both to address past and present grievances, and as a prerequisite to market-oriented solutions to water-use inefficiency. Although Special Envoy Eric Johnston negotiated such an agreement between Israel, Lebanon, Syria, and Jordan in an extensive process from 1953-1955, the agreement was never ratified. Forty years later, the agreement is somewhat outdated. The Palestinians were not considered a separate entity at the time and, consequently, they received no explicit allocation. Also, the issue of groundwater, which has since become a point of contention, was not considered. In this section, updated guidelines for allocation of the water of the Jordan River watershed are considered. Emphasis is on Jordan, Israel, and the Palestinians of the West Bank and Gaza.

One issue at the heart of the negotiating process will be each party's definition of *equity*, which is an inherently vague and relative term. Criteria for equity are particularly difficult to determine in in-

ternational water conflicts, as legal guidelines are poorly developed at this level. For example, measurements of equity are convoluted by the question of whether areas within a riparian state, but outside of the watershed boundary, should be included for consideration in the allocation process. Some of the criteria by which water conflicts have been assessed by legal authorities and others in past international negotiations are expressed by the following concepts:[41]

LEGAL CONCEPTS.

1) Absolute sovereignty. A state has absolute rights to water flowing through its borders.
2) Riparian rights. Any territory along a river way has rights to a relatively unchanged river. "Unchanged" might be expressed in quantity and/or quality terms.
3) Prior appropriation. Rights are expressed chronologically, with early users gaining rights through historic use. Often referred to as: "First in time, first in right."
4) Optimum development of the river basin. The basin is considered a single hydrologic unit, and it is incumbent upon states to develop it accordingly.
5) Reasonable share or equitable use. Provides rights dependent on some or all of the above criteria, but is difficult to interpret.

OTHER MEASURES.

6) Economic efficiency. The ability to achieve the most return per unit water earns "rights" through the invisible hand of the free market.
7) Proportional rights. Rights are allocated in proportion to the quantity of a river's sources which originate within a nation's territory.
8) Per capita rights. Equal per capita allocation to each of the coriparian states.
9) Power. In the absence of any agreement on the above, force is sometimes used to achieve "equity" as defined by the party with the greatest power.

Another important issue to be taken into account to ensure successful negotiations is a the matter of *control.* Water for personal use and subsistence agriculture is clearly a most fundamental human need. Additionally, much of a nation's economy may depend upon a reliable

41. *See* A. Utton, *The Development of International Groundwater Law,* 22 Nat. Res. J. 95 (1982); D. Caponera, *Patterns of Cooperation in International Water Law: Principles and Institutions,* 25 Nat. Res. J. 563 (1985); G. Cano, *The Development of the Law in International Water Resources and the Work of the International Law Commission,* 14 Water Int'l 167 (1989); Israel/Palestine Center for Research and Information (hereinafter *IPCRI*), *Rroundtable on the Issue of Water* (unpublished transcripts of ongoing roundtable discussions, including simulated negotiations, begun November, 1990, on file with author).

source of water for export agriculture and industry. Consequently, the need for control of a stable source of water can be urgent and absolute in relevant foreign policy decisions, and many of the obstacles to past water negotiations have concerned this issue. During the Johnston negotiations, for example, the Unified Arab negotiators strenuously resisted any storage of the Yarmuk River (which originates in Syria and Jordan) in the Sea of Galilee (lying wholly in Israel), although such storage was shown to be less expensive than building a new storage facility.[42] Israel, in turn, objected to international control of annual allocations, viewing this as an infringement of its sovereignty. In more recent years, Israel has resisted many proposals to import water from sources in Egypt and Turkey. For example, when President Anwar Sadat offered in 1979 to bring water from the Nile River to the Negev Desert, then-Israeli Minister of Agriculture Ariel Sharon expressed an aversion to the lack of control of a water source common to many water-managers: "I would hate to be in a situation," he is quoted as saying, "in which the Egyptians could close our taps whenever they wished."[43]

In short, between the two formidable issues of equity and control, negotiations would be contentious, with conflicting claims and disputed criteria for evaluation. The approach that Eric Johnston took to these two issues might inform current negotiations.

Equity

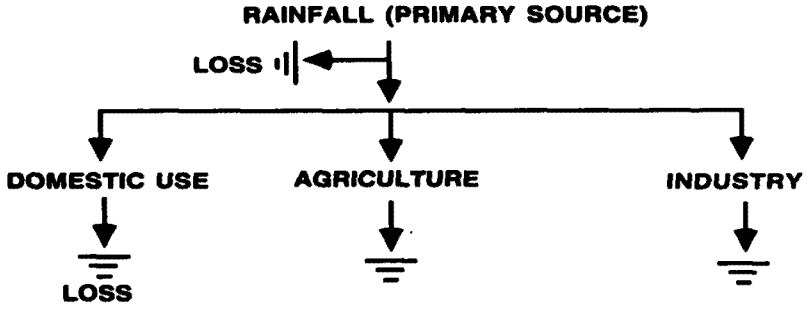
Johnston measured equity by the amount of water each state could reasonably use in the future on its irrigable land within the watershed boundary. This gave a concrete measurement by which to achieve his proposed allocations. Once the allocations were reached, each state could do what it wished with the water, including transferring it out-of-basin. This was not only an acceptable formula to the parties at the time, but it allowed for a breakthrough in negotiations when a survey of Jordan's irrigable land concluded that Jordan's future water needs were lower than previously believed. This concept of developing an objective, needs-based measure for future demand is still applicable today. However, because current emphasis is on meeting personal consumption and industrial requirements, agricultural water needs would not be as relevant a measure.

42. *See, e.g.*, G. Stevens, Jordan River Partition 31 (1965).

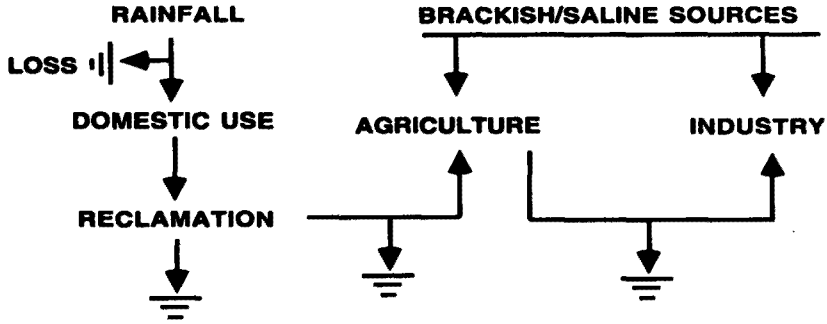
43. L. Spector & G. Gruen, *Waters of Controversy: Implications for the Arab-Israel Peace Process*, American Jewish Committee (December 1980).

TABLE 5: TRADITIONAL AND INTENSIVE WATER MANAGEMENT

I. TRADITIONAL MODEL:



II. INTENSIVE MANAGEMENT MODEL (SEQUENTIAL REUSE):



The ultimate measure of water demand is that amount required for personal consumption. Population growth in the area is approaching the point where *all* of the annual renewable supplies of a watershed will have to be allocated first to personal use.[44] Table 5 shows schematically the attendant conceptual shift in water management, from the traditional mode where water from the primary source is used once and then lost, to an intensive management model where water is used sequentially for several needs and managed constantly for the most appropriate use for its quality.

Natural annual water availability in those areas dependent upon the Jordan River watershed—Israel, Jordan, the West Bank, and

44. Ben-Meier *cited in IPCRI, supra* note 37; H. Shuval, *Approaches to Resolving the Water Conflicts between Israel and her Neighbors—A Regional Water-for-Peace Plan* (1991)(unpublished manuscript, on file with author).

Gaza — is approximately 2500 MCM/yr.[45] This amount reflects the natural supply of renewable freshwater, the "primary water source." It includes usable rainfall, snowmelt, and the renewable recharge to shared aquifers. It excludes secondary sources such as reclaimed wastewater; desalinated, fossil or saline groundwater; and freshwater aquifers lying wholly within a state. At an allocation of 100 cubic meters per capita, an amount commonly used for planning purposes,[46] all of this amount will be used first for personal consumption when the combined Israeli/Jordanian/Palestinian population reaches 25 million, expected by the first half of the next century.[47] Water for agriculture and industry then will have to come *entirely* from wastewater reuse, desalination, or interbasin water transfers.

Population projections can be calculated easily to estimate each entity's percentage of the total regional population. These proportions then can be applied to the primary water source. In the above example, when the combined population reaches 25 million, the population by entity will be about ten million each in Israel and Jordan, three million in the West Bank, and two million in Gaza. Applying these proportions to the water supply, 1000 MCM/yr. each would be allocated to Israel and Jordan, 300 MCM/yr. to the West Bank, and 200 MCM/yr. to Gaza. The comparison between current and proposed allocations is shown below:

ALLOCATIONS OF PRIMARY SOURCE

	Current	*Proposed*
Israel	1,500MCM/yr	1,000 MCM/yr
Jordan	800	1,000
West Bank	110	300
Gaza	60	200

It should be stressed that these values are estimates for purposes of illustration only. The actual allocations would have to be negotiated between the parties involved. Also, the allocations are based on average amounts and do not take into account variability in water quality, development costs for each source, or the issue of storage. These factors, too, would have to be dealt with by the parties. Since water allocations would be based on population, water negotiations would be combined with issues of immigration and population growth, issues which will have to be dealt with anyway in the course of regional peace talks.

In any event, these allocations could be reached gradually, allowing each entity both time and incentive to develop the most pro-

45. *See* Table 1, p. .

46. TAHAL Water Planning for Israel, Master Plan for Water (1988).

47. See extrapolations for population and water supply and demand for the region in Tables 1-3, *infra*.

ductive combination of reuse and new sources to provide for agricultural and industrial needs. Furthermore, once these allocations are established as property rights, international water markets or technology-for-water transfers could be established to allow market forces to help determine the most efficient means of water distribution and application.

Water *per se* is a zero-sum commodity, but the benefits water can provide are variable and, therefore, tradable for integrative ("win-win") solutions. For example, the above allocations would increase Palestinian water supplies and decrease Israeli supplies. Since Palestinians currently use significantly less water per capita than Israelis, Palestinians could sell surplus supplies to Israel or exchange the surplus for water-saving technology. These arrangements would encourage efficiency on both sides.

Control

Johnston also addressed the issue of control, eventually allowing for as much of a state's water allocation as possible to originate within its borders. For example, Israel's allocation came mostly from the Jordan River headwaters, while Jordan's share came from the Yarmuk River.[48] Additionally, Johnston addressed the related issue of variability in annual water supply by determining which of the participants' water sources was defined as "residue," i.e., a source to be allocated only after the other states received their shares. This set a hierarchy of priorities for allocations of the water supply, which fluctuated both seasonally and annually within each waterway.

Although the Johnston allocations will have to be re-negotiated, the principles of the original negotiations could be retained. For example, the bulk of the water allocated to Israel and Jordan could still originate from the Jordan and Yarmuk Rivers, respectively, and the majority of Palestinian sources could come from the groundwater beneath Palestinian territories.

B. Negotiations Over The Mountain Aquifer

As outlined previously,[49] one of the most contentious issues between Israelis and Palestinians is the status of the Mountain Aquifer. By closely examining the claims of both Israel and West Bank Palestinians to this groundwater, insight may be gained on how to resolve this aspect of the water conflict.

48. U.S. Department of State, *The Jordan Valley Plan (Summary of Johnston Negotiations)* (September 30, 1955; revised January 31, 1956)(unpublished report on file with author).

49. *See* text *supra* at note 16.

The Mountain Aquifer is actually three hydrogeologic units, all three of which recharge in the Judean Hills on the West Bank. These units are known as the Western Aquifer, which flows west to Israel and the Mediterranean; the Eastern Aquifer, which flows towards the Jordan River; and the Northeast Aquifer, which flows towards the Jezreel Valley. Their annual safe yield and current use is as follows:[50]

	Yield, MCM/yr.	*Consumption, MCM/yr.*	
		Israel	*Palestinians*
Western Aquifer	320	300	20
Eastern Aquifer	125	75	50
Northeast Aquifer	140	120	20

Total consumption within the West Bank is 35 MCM/yr., mostly from wells, for Israeli settlements, and 115 MCM/yr., from wells and cisterns, for Palestinians.

The initial claims by each party for these aquifers can be summarized as follows:

Israel

Israel considers irrevocable its historic rights to the water it currently uses. Israel has been pumping the Western Aquifer from the Israeli side of the Green Line since 1955; Israel views with trepidation the loss of upgradient control of this Aquifer. Measures taken to restrict Palestinian pumping on the West Bank are viewed as defensive, as necessary to protect the quantity and quality of Israeli water. The total amount which might be claimed by Israel is 495 MCM/yr., plus control of water resources development across the entire West Bank.[51]

Palestinians

Palestinians have claimed first rights to all of the ground- and surface-water which originates on the West Bank,[52] and have objected to Israeli controls. Palestinians were also to receive 70-150 MCM/yr. from the Jordanian share of the Johnston negotiations. The total amount claimed by the Palestinians might come to 655-735 MCM/yr., plus control over water resources development over all of the West Bank.

The issue of water quantity was dealt with in the previous section.[53] It would be difficult to accept either the Palestinian claim to all of the water originating on the West Bank, or the Israeli claim to 85

50. TAHAL, *supra* note 42.

51. The background for these positions can be found in Wolf *supra* note 11. Appendix III in that work includes position papers on the subject from the Israeli Ministry of Agriculture.

52. *See,* Zarour and Isaac *supra* note 14.

53. *See* text *supra.*

percent of this water. Again, future per capita needs might be used as a basis for both claims. By this token, West Bank Palestinians would gain rights to a total of 300 MCM/yr., as compared to their current use of 110 MCM/yr. Israel would go from current total allocations of 1,500 MCM/yr. to 1,000 MCM/yr.; the loss would be made up through desalination, wastewater reclamation, or water purchases.

The remaining issue is control. The Israeli claim that control over all of the West Bank is necessary for its "water security" is hydrologically unsound. Because of the flow of groundwater, it would be difficult for Palestinians to impact Israeli wells in the Western Aquifer if Palestinians acquired control of the Eastern Aquifer. Furthermore, because of the great depth from the land surface to the water table in the Judean Hills, Israeli water managers have suggested that control of as much as two thirds of the area overlying the Western Aquifer might be relinquished, without overly jeopardizing Israel's water supply.[54]

The Palestinian claim to control of the water resources of the entire West Bank is likewise difficult to accept. Just as Israelis must come to accept the Palestinian need for control, Palestinians must recognize Israeli concerns for water security. If the above water allocations are accepted, at least 400 MCM/yr. of Israeli water would still originate on the West Bank, and Israel would be remiss in not guaranteeing its future supply before relinquishing control.

Several steps might address the twin concerns of Palestinian control and Israeli water security. The first might be to emphasize surface water development on the West Bank. As mentioned, Jordan still "owes" the West Bank 70-150 MCM/yr. from the Johnston accords. [55] Although Jordan has its own water deficit, this water might be acquired through a series of water exchanges, as described below.[56]

Another step might be to take advantage of topography to provide a mutual guarantee of Palestinian and Israeli supplies. Because of the hydro-geology and the disparate depths of the water table near the Mediterranean coast and in the Judean Hills, it is both less expensive and more efficient to pump water from the Mountain Aquifer at the

54. Wolf, *supra* note 11, at 134-135. Because of the disparate depths from the land surface to the water table in the Western Mountain Aquifer beneath the coastal plain and the Judean Hills (about 60 meters in the plain, 150-200 meters in the foothills, and 700-800 meters in the Hills), and the resulting cost differences in drilling and pumping wells in each of these areas, Menahem Cantor, then-Israeli Water Commissioner, concluded in 1977 that a "red line" could be drawn beyond which Israel should not relinquish control, north to south following roughly the 100-200 meter ground-surface countour line. This "red line," still used by Israeli water planners as a frame of reference, leaves control of the water resources underlying approximately two-thirds of the West Bank open for negotiations.

55. *See* text *supra* at note 16.

56. *See infra* notes and accompanying text.

Israeli wells and then pipe it to the hills of the West Bank, than it is to pump directly in the Judean Hills. This suggests a mutually dependent system of water delivery, whereby Palestinian water is pumped at existing Israeli wells, perhaps jointly managed, and then piped to Palestinian users. Since the Palestinians are upgradient and could in turn threaten Israeli supplies, each party would have a "hand on the tap" and, therefore, each would have incentive to cooperate.

The final step in addressing the issue of control would focus on the problem of water quality and the threat to its degradation. Israeli concerns about upgradient Palestinian control extend beyond threats to water quantity and include dangers to water quality. Palestinian industrial development could threaten the quality of water in Israeli wells, even unintentionally. Some sites on the West Bank are more susceptible to groundwater contamination than others. A joint Israeli-Palestinian committee to establish zones of groundwater susceptibility by investigating soil type, rock formation, and groundwater flow movement, might give Israel more confidence to release control. This might, in turn, provide Palestinians with a useful basis for a plan for development on the West Bank, which would help protect Palestinian water supplies into the future as well.

Any combination of the above steps for addressing both Palestinian concerns about control and Israeli needs for security could help to break a difficult impasse. Each approach might also have positive repercussions on other water conflicts. Some possible combinations include:

1) Israel could give up its claim to the eastern side of the Mountain Aquifer in favor of Palestinian control. In exchange, Jordan could accede to Israeli claims on the Yarmuk River, which claims then could be supplied by gravity to Israeli settlements in the Jordan valley. Syria might then agree to allow the Yarmuk to flow unimpeded to Jordan and Israel. Turkey might increase the Euphrates River flow to Syria by the relatively small amount that Syria would forego from the Yarmuk.

Alternately, Israel could waive its claim to the Yarmuk if Jordan reassumed responsibility for supplying the West Bank with ample surfacewater for the West Bank's development needs. This, in turn, would alleviate Israeli concerns about Palestinian groundwater exploitation.

2) Either of the above agreements would allow the Unity Dam project to proceed. During construction, Israel could allow Jordan to store Yarmuk River winter runoff in the Sea of Galilee, thereby both allowing a stable Jordanian water supply during the dry summer months, and reducing the salinity levels in Israel's main reservoir.

3) Negotiations would then focus on the western part of the Mountain Aquifer, and on methods of joint inspection and planning between Israelis and Palestinians.

C. Large-Scale Regional Desalination Projects

A final example of cooperation-inducing design involves plans for a large-scale regional desalination project. In guidelines from history, it was noted that, "the more complex a project is technically, the more complex it is politically."[57] Although at first glance the project which follows seems fairly complex, is argued that, if attention is paid to detail, it can be designed as a series of smaller projects, each with the potential to be developed larger and with increasing cooperation as technical and political developments proceed.

What follows is a conceptual proposal for a regional desalination complex, including sections on:

1) Background: The Agro-Industrial Complex (1960s) and the Med-Dead Canal (1980s).
2) Project Description.
3) Economic Considerations.
4) Environmental Impact.
5) Implementation in the Framework of a Regional Water Development Plan.

1) HISTORICAL BACKGROUND: THE AGRO-INDUSTRIAL COMPLEX AND THE MED-DEAD CANAL

Immediately after the Six-Day War of 1967, former United States President Dwight D. Eisenhower, Lewis Strauss of the Atomic Energy Commission, and Alvin Weinberg, Director of the Oak Ridge National Laboratories, developed a "water for peace" project of massive scale for the Mideast. It included a series of nuclear desalination plants that would have provided power and water for immense "agro-industrial" complexes which, it was hoped, would have eased political tensions caused by refugees and water scarcity.[58]

The plan was given a boost by Senate Resolution 155,[59] which expressed support for development at three likely sites in Egypt, Israel, and Jordan. Recently declassified reports show that a fourth site, at Gaza, was also planned in conjunction with a project for refugee resettlement.[60] The plan eventually faltered on political and economic grounds, and due to concern about the dangers of introducing nuclear

57. *See* text *supra*.

58. Oak Ridge National Laboratory, *Middle East Study Application of Large Water-Producing Energy Centers: Summary* (1971); L. Strauss, *Dwight Eisenhower's "Proposal for Our Time,"* 19 Nat'l Rev. 1008 (1967).

59. 90th Congress, 1st Session (1967).

60. Oak Ridge National Laboratory, *Middle East Study Application of Large Water-Producing Energy Centers: Gaza Area Development and Refugee Resettlement* (1970)(draft on file with author).

technology to the region. Nevertheless, two years of cooperative research between Americans, Arabs, and Israelis, along with lessons learned during the Johnston negotiations 12 years earlier, showed that, on the technical level at least, cooperation over regional water resources and planning was possible.

Fifteen years later, in the early 1980s, the Israelis began planning a canal, designed primarily for hydropower, to bring Mediterranean seawater across the Negev Desert and under the Judean Hills, and drop it 400 meters to the Dead Sea, the lowest point on earth. The 800 megawatts (MW) that would have been made available by this Med-Dead Canal would have just equaled the cost of the project, estimated at $1.5 to $5 billion. The benefits of several ancillary projects for cooling or for artificial lakes made possible by the saltwater, added viability to the scheme.[61] That project was finally shelved, mostly due to the question of cost estimates.[62]

Although an exciting project, the Med-Dead Canal focused on power generation rather than water generation, and it was unilateral in scope, bringing benefits only to Israel. In fact, Palestinians objected to the site of the intake, proposed for Qatif, on the ground that it would further integrate Gaza with Israel; Jordan protested the anticipated rise in the level of the shared Dead Sea; and three separate resolutions condemning the proposal were brought before the United Nations General Assembly. Jordan took the opportunity, however, to investigate the possibility of a similar, but even more short-lived, project of its own—the "Red-Dead" Canal.

The "Red-Dead" Canal would have been similar to the Med-Dead Canal, with the major difference being the source of water for hydropower—in this case, the Red Sea. The project was designed as a peaking facility whose four hydropower facilities would have a total capacity of 334 MW and would have generated an average of approximately 975 gigawatt-hours per year.[63]

2) PROJECT DESCRIPTION

The best aspects of the two types of projects—the regional approach and emphasis on international cooperation of the Agro-Industrial Complex and the comparatively safe energy applications of the Med-Dead or Red-Dead Canal—might be combined and expanded for a new hybrid project for water and power for the 1990s. The project, in turn, could be incorporated into a badly needed regional water development plan for the Mideast.

61. *See generally* Mediterranean-Dead Sea Co. Ltd., Mediterranean-Dead Sea Project: Outline Design-Summary and Conclusions (1983).

62. *Id.*

63. Harza Engineers, unpublished feasibility study (1979).

The core of the complex would be either a Med-Dead or a Red-Dead canal (see Figure 2—International Borders), with a new emphasis on desalination fueled by hydropower and augmented with solar and conventional energy generation. In contrast to the earlier plans, which focused on power generation and unilateral development, a new approach would make available, in sparsely populated areas, power and fresh- and saltwater for agriculture, fish ponds, industry, and even recreation on artificial lakes, to the benefit of populations from Egypt, Israel, Jordan, Gaza, and the West Bank. The scope of the project could expand, depending upon cost, financing, and which of the countries and territories of the region became involved; greater benefits would accrue with larger scale involvement.

Although more groundwork has been done on the Med-Dead route than on the Red-Dead route, most of the components of the project can be adapted to either location should the Red-Dead route become more technically or politically attractive. Either way, the focus on water, rather than power, and an emphasis on cooperative regional development instead of unilateral benefits, could add both the economic and the political viability that earlier plans lacked.

The original Med-Dead saltwater canal would have been sited in a particularly opportune position to foster regional cooperation. The intake would have been located in or near the Gaza Strip, which is the site of some of the most squalid and densely populated refugee camps in the world, as well as of severe groundwater overdraft. The Canal itself would have run parallel to the Egyptian-Israeli border. Were Egypt and Israel now to set aside some of this sparsely populated land, power and water from the proposed project could be routed to a trinational (Egyptian-Israeli-Palestinian) agro-industrial site in the Negev-Sinai Deserts. A Red-Dead route would likewise provide the opportunity for a Jordanian-Israeli-Palestinian complex.

Ample agricultural land exists along both the Med-Dead route and the Red-Dead route. Agricultural possibilities are limited currently only by the lack of a stable freshwater supply. A large plain south and east of Gaza and El-Arish, the Plain of Pelusium, is one potential site for the Agro-Industrial Complex, because the area is suitable for a wide variety of agriculture.[64] Equally suitable tracts exist further inland in both the Sinai and Negev Deserts. These could be used if the intake were placed at Qatif, as planned for the Med-Dead Canal.

If a Red-Dead route were used, agriculture and industry could be developed in the Arava Valley on both sides of the Israel-Jordan

64. In 1902, the Plain of Pelusium was suggested as a possible site for a Jewish State by Theodore Herzl. The British refused to agree to this idea, claiming that the Nile water which would be needed for irrigation could not be spared. *See*, U. Ra'anan, The Frontiers of a Nation, 36-37 (1955).

border. The development in this region has been limited only by a lack of a steady freshwater supply. Both Israel and Jordan are currently attempting to overcome the natural limits through water transfers; both countries foresee this area as the eventual terminus of their respective national water carriers. Joint development and a local water supply would eliminate the need for redundant planning and piping.

Either the Med-Dead or the Red-Dead project, as originally envisioned, would be ideally suited for clean power generation. Hydropower could be generated at, or along the way to, the Dead Sea. High-temperature solar electricity also could be generated—the region has 300 cloudless days a year.

The crucial contribution of the project, however, would be water, with power as a useful byproduct. Current research into the concept of solar ponds suggests that water of two distinct salinities will trap heat in the lower, denser layer. The heat differential can be exploited to power turbines, or to fuel distillation desalination. In the present instance, the relatively low saline water of the Mediterranean Sea or Red Sea would cover a layer of more salinated Dead Sea water.[65] A five MW plant demonstrating this process recently went on-line at the Dead Sea.

One estimate is that the Dead Sea itself could support a 450-square kilometer solar lake, operating a 2500 MW power plant, if the low saline water were made available.[66] If a dual purpose plant for power generation and distillation desalination were built at the intake (as proposed along the Mediterranean coast ,or at Aqaba in any event), the brine resulting from the desalination process could be used for smaller, self-perpetuating solar pond/desalination plants all along the route to the Dead Sea. The brine would be used as the high-saline layer, while water from the Mediterranean or Red Sea would be used for the upper, low-saline layer. The project thereby could grow as power or water demand increased. The brine, which is a by-product of any desalination process, also could be used readily in the already-active potash and salt works of Israel and Jordan at the Dead Sea.

The 400-meter drop at the Dead Sea could be used not only for hydropower generation, but also for reverse-osmosis desalination. This pressure dependent method of desalination uses pressure and selective membranes. It would add even more to the potential freshwater output.[67]

65. B. Doron, et. al., *Solar Pond as an Actual Solution for Desalination* (August 1991)(presented at the IDA World Conference on Desalination and Water Reuse).

66. E. Stern & Y. Gradus, *The Med-Dead Sea Project—A Vision or Reality?* ,12 Geoforum 268 (1981).

67. P. Glueckstern, Preliminary *Considerations of Combing a Large Reverse Osmosis Plant with the Mediterranean-Dead Sea Project*, 40 Desalination 143 (1982).

The cost of desalinated water would be sharply reduced if brackish water were used instead of seawater. As it happens, brackish fossil aquifers have recently been discovered precisely in this area, in and below the Nubian Sandstone formation underlying the Negev and Sinai Deserts. These aquifers could be tapped for at least 300 MCM/yr. of water into the next century. Recent research at the Ben-Gurion University of the Negev Desert suggests that even more brackish-to-saline groundwater might be available in these aquifers than previously thought.[68]

If enough freshwater became available through a combination of these processes, it could be exported to other areas of chronic shortage such as the West Bank or Jordanian cities. The water itself need not be piped to these regions. Rather, a surplus at Gaza or in the Negev Desert would allow for a water transfer from the northern sources of the Jordan River, abundant but currently fully exploited, to be effected. Additional Yarmuk River water could go to Amman, for example, or more of the storage in the Sea of Galilee could be allocated to Haifa or Ramallah. Cooperative planning would allow for greater alternatives for such reallocations, and would enable the most efficient and economical management plans to be developed for the region's waters.

A Med-Dead or Red-Dead agro-industrial project as described above would take advantage of vast, sparsely populated lands for agricultural and industrial production utilizing two ports (Gaza and/or Eilat/Aqaba), add impetus to regional cooperation and refugee resettlement, and help alleviate the area's water shortage. Because of the relatively high cost of water produced through desalination and the consequent necessity of using such high-priced water most efficiently, the Agro-Industrial Complex might become a showcase for the cutting edge of desalination techniques and efficient water use. Carried out jointly between researchers from the region and abroad, the results would be of benefit to arid regions around the world. Employment at all levels also would be provided for dangerously under employed groups, such as Palestinians from Gaza and the West Bank, and Israeli immigrants from Ethiopia and the former Soviet Union. New sources of water and power would provide opportunities for a range of ancillary projects, from inland power plants, to artificial lake resorts, to saltwater aquaculture. These projects could induce people to migrate inward and away from the crowded Mediterranean coast, and might eventually support entire towns.

The Med-Dead route and the Red-Dead route would each face clear obstacles in terms of political viability, as have all plans for re-

68. R. Nativ, et. al., *Potential Use of the Deep Aquifers in the Negev Desert, Israel—A Conceptual Model*, 94 J. of Hydrology 237 (1987).

gional cooperation. One optimistic note, though, is that proponents of both the Med-Dead and the Red-Dead Canals include prominent nationalists on both sides of the Jordan River. Israeli Minister of Science and Technology Yuval Ne'eman of the right-wing Tehiya party has been actively supporting the Med-Dead Canal since its inception, and Jordanian Crown Prince Hassan has been a principle advocate of the Red-Dead Canal.

3) ECONOMIC CONSIDERATIONS

The project would not be inexpensive. The cost of the original Agro-Industrial Complex was put at about $1 billion by a 1967 estimate that was made before nuclear plant decommissioning costs were included in analyses.[69] A 1982 estimate put the Med-Dead Canal costs at anywhere from $1.5 to $5 billion, even without the ancillary projects.[70] Nevertheless, both of the original projects were calculated at least to break even in the cost-benefit analyses.

It is assumed that a cooperative project, presented in the context of a Mideast working towards peace, would offer several features to help tilt the balance in the project's favor. First, such a project would undoubtedly spark the interest of and induce financing from agencies and individuals interested in fostering Mideast cooperation. United States, European, or World Bank grants or soft loans would add economic viability to the project. Adding "induced cooperation" as a benefit to water project evaluations would help even further. Cooperation *per se* has not been recognized yet as a tangible benefit in cost analyses, at least not by the World Bank.[71] Additionally, the joint research and development components for desalination technology and efficient water use would qualify the project for the Middle East Regional Cooperation (MERC) program at the United States Agency for International Development.

Second, even without an anticipated Marshall Plan for a Mideast at peace, one might assume a certain "peace dividend" from countries no longer locked in a regional arms race. This dividend might be reallocated to peaceful development. Water resource development is high on the list of priorities for all parties in the region, particularly in light of both imminent and ongoing influxes of immigrants and refugees. Pooled investment resources and planning would allow for greater flexibility in design and, consequently, would lead to greater economic efficiency in development.

Third, if Saudi Arabia or other Gulf states could be persuaded to back the scheme, their support might come in the form of inexpen-

69. Oak Ridge National Laboratory, *supra* note 52, at 56.

70. Mediterranean-Dead Sea Co. Ltd., *supra* note 55, at xiv.

71. J. Olivares, *The Assessment of Water Resources Projects Involving Economic, Social and Environmental Costs and Benefits: The World Bank's View*, 10 Nat. Resources F. 2 (1986).

sive oil or natural gas for conventional power generation, with co-generation desalination capability. This could substantially reduce the cost of these components of the project.

Fourth, although a 30-year project life was assumed in the calculations for the original Med-Dead Canal, there is no reason that this has to be the case. The flow rate of the canal would have to be cut back after a 20-year "filling period" when the Dead Sea reaches its historic level, but even then, a 1250 MCM/yr. flow, which would just match evaporation rates, would not require an overly sharp drop in power generation. Unlike a nuclear power plant, or even a dam, a Med-Dead or Red-Dead canal, with the proper maintenance, could function indefinitely. Once the project is amortized, power and water generation would become extraordinarily inexpensive.[72]

4) ENVIRONMENTAL IMPACT

As with all grand schemes, the environmental assessments of a Med-Dead or Red-Dead canal would need to be honest and rigorous. Many such projects have passed muster with cost-benefit analyses calculated by proponents who deliberately or inadvertently ignored environmental costs. It is heartening to note that not only were the environmental impacts assessed for the original Med-Dead Canal, but that those conducting the study seemed to have taken their work seriously, and to have been cognizant of the aesthetic value of this desert environment. "With the onset of fall," they wrote of the Jordan Valley plants, "the leaves turn yellow and color the river landscape. The Jordan tamarisk is evergreen and colors the landscape with its pinkish-white blooms in the spring and summer. . . "[73]

The environmental dangers in this case would not come just directly, from the movement of saltwater through fragile desert ecosystems, but also indirectly, from inland population movement or from the necessary infra-structure, for example. Other hazards would include the unknown consequences of mixing water from two chemically distinct sources; one researcher suggests that the result could be floating clumps of plaster of Paris.[74] These dangers would have to be emphasized throughout the project's implementation.

One clear environmental benefit of the project would be the restoration of the Dead Sea to its historic level. Before the national water projects of Israel and Jordan began diverting freshwater upstream in the 1960s, the inflow of freshwater to the Dead Sea just matched the rate of evaporation, and the lake level remained fairly constant. Since that time, the level has dropped significantly, with an

72. *Cf.*, A. Weinberg, *'Immortal' Energy Systems and Intergenerational Justice*, ENERGY POLICY, 51 (Feb. 1985).

73. Mediterranean-Dead Sea Co. Ltd., *supra* note 55, at Part II, p. 26.

74. P. Ross. *Med-Dead Canal: New Life for an Old Idea*, Barron's (Dec. 5, 1983).

accompanying reduction in surface area.[75] Early diversion schemes[76] each included, from the turn of the century onward, an attendant project to ameliorate the effects of the loss of inflow to the terminal lake. Without such a project, the Dead Sea will continue to drop and shrink. Although not much wildlife is being affected (except for bacteria, the Dead Sea is appropriately named), potash works and health resorts on both shores will continue to contend with the costs of an increasingly distant shoreline. With inflow from either the Mediterranean or the Red Sea, the Dead Sea would be restored to its historic level after about 20 years. The amount of inflow would then be pared back to equal the natural evaporation rate.

A dispersion of populations away from the congested and increasingly polluted population centers may also reduce health risks, especially from air pollution. Furthermore, the proposed canal would encourage an emphasis on solar desalination techniques, which are significantly less polluting than the planned alternative of coal-fired dual-purpose plants.

Environmental concerns may help determine the most desirable route for the project. It should be noted, for example, that the Med-Dead route would tunnel saltwater directly through the heart of the Mountain Aquifer of the Judean Hills, upon which the entire West Bank population depends, and upon which Israel relies for 30 percent of its water supply. The possibility of potential environmental degradation effectively vetoed an earlier proposal for a canal project through the Jezreel and Jordan valleys.[77]

5) COOPERATION-INDUCING STAGES OF IMPLEMENTATION IN THE FRAMEWORK OF A REGIONAL WATER DEVELOPMENT PLAN

Once the legal and economic foundations have been laid for ownership and distribution of current sources, and the existing water supply and demand system is functioning at maximum efficiency, as described above,[78] a project of the scope of a Med-Dead or Red-Dead canal could begin to be implemented. At this point, too, it would be important to approach the project in stages, checking constantly for economic, technical, and environmental viability, and using each step to induce cooperation for completion of the whole.

The first phase could begin immediately, even as peace negotiations are in progress. A traditional, coal-fired, dual-purpose en-

75. I. Steinhorn & J. Gat, *The Dead Sea*, 249 Sci. Am. 102 (1983).

76. Theodore Herzl, for example, described a Med-Dead Canal in ALTNEULAND (1902, at 209), his Utopian version of the future of Zionism.

77. Stern & Gradus, *supra* note 59, at 267.

78. *See supra* notes and accompanying text. [whatever corresponds to manuscript pages 17-20].

ergy/desalination plant could be built in Gaza, the most parched of the areas under discussion (the plant would be at Aqaba for a Red-Dead route). For either route, the plant would be designed both to expand with demand, and to serve later as the intake site for the canal. Meanwhile, a pumped-storage facility would be built at the Dead Sea for Israeli or joint Israeli and Jordanian use. Such a facility would pump water up to a higher level of storage during off-peak hours, and then would generate hydropower electricity when demand peaked. This facility would be designed for later incorporation into the canal project, to generate hydropower with Mediterranean or Red Sea water. Both of these projects would have been in the planning stages for some time already, but coordination would be important in order to proceed to the next phase.

Once the intake and the power generation facilities were in place, even under different sovereignties, the incentive to connect the two and, later, to develop the consequent ancillary projects could be powerful enough to induce ever-increasing cooperation. Projects such as solar-pond desalination at both the Dead Sea and along the canal, reverse osmosis desalination, aquaculture, and inland industry, would be feasible only with linkage of the two facilities.

The canal project would not only be ideally suited for development in such a step-wise fashion, dependent upon increasing confidence-building incentives, but also could be expandable, designed to incorporate additional components as future power and water needs grew.

CONCLUSION

In this paper, the general approach of water conflict analysis, and the site-specific lessons learned from the history of the Jordan River watershed are brought together to try to gain insight into how both the water crisis—the shortage of water within the basin—and the water conflict—the political tensions attendant to the lack of water—might be resolved.

The current technical, economic, and political viability of all the technical and policy options available in the Jordan River watershed suggests a four-stage process of watershed development to solve the water crisis. The first two stages, establishing water rights for the existing resource, and developing policies to allow for greater efficiency for regional supply and demand within the watershed, might be developed concurrently. Only then might water imports be investigated for economic and political viability. The final stage of development, once politics and economics allow, might focus on a regional desalination project, perhaps modeled on a combination of an Agro-Industrial Complex and a Med-Dead or Red-Dead Sea canal.

If there is a possibility that the parties involved would agree to any of the stages in this process, and that the "water conflict" thereby would be solved along with the "water crisis," then making the possibility a reality may depend primarily on how the projects are packaged, not just from a technical standpoint, but also from the political perspective. By incorporating the political interests of each party into each stage of development—that is, by designing each stage for ever-increasing integration while guaranteeing that concerns over equity and control are constantly addressed—the dimension of "cooperation-inducing design" is added to three examples: a regional water-sharing agreement, the allotment of use of the Mountain Aquifer, and a Med-Dead or a Red-Dead canal project for regional desalination.

Where nature has conspired to bring together in the Mideast the unique ingredients of climate and topography necessary for clean power generation, it has also deprived the region's inhabitants of the most vital of all resources—water. Nations have further conspired to make difficult the achievement of any cooperative solutions to the water shortage. Now, however, populations and economies in the region are growing to the point that people can no longer afford the proclivities toward conflict. Ironically, water just may be crucial enough an issue to force ancient enmities aside. People who will not talk about history or politics may, if their lives and economies depend upon it, talk about water.

As Lewis Strauss wrote about the original Agro-Industrial Complex 25 years ago, "Water is an eloquent advocate for reason."