Review and Evaluation of Certain Aspects of the Spanish National Hydrological Plan (NHP)

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Caveat: This position is presented in my personal capacity, and not on behalf of any institution with which I am associated.

Introduction

I have been asked by the Government of Aragon to provide a review and evaluation of certain aspects of the National Hydrological Plan. The assigned task is to focus on options for meeting the water needs of the target areas by means other than bringing in additional water by transfers from the Lower Ebro River, including:

- Reduction of urban water use through demand management;
- Production of desalinated water in the target areas;
- Use of treated wastewater for suitable uses;
- Improved management of groundwater aquifers.

The review is based on the materials listed in an Appendix.

Point of View

My perspective on the NHP is supported by 35 years of professional work in the domain of water resources management, primarily in Israel, with assignments in Canada, the US, Holland and China.

Urban Water Demands and Options for Their Reduction

Sections 9.1.1 and 9.1.2 in [2-a] provide background material and analysis on present and forecasted urban water demands.

The 1995 demand level in the area to be served tends to be in the 300-350 l/cap/day (110-124 m^3/cap/year). While this level is not excessive in comparison with other Western countries in similar circumstances, and is the same order as the per capita consumption in Israel, there is room for better efficiency and thereby a reduction in this water requirements.

Estimates of the potential for reduction in urban water consumption conducted in various places around the world; starting from the level quoted above, range in the order of 5-25%. There are two relevant time horizons to be considered:

- Long-term: over a period of years, to reduce the average annual and seasonal water consumption, and
- Short-term: temporary reduction of use during times of shortage.

Long-term reduction of water consumption influences planning and capacity expansion plans, such as the NHP, as demands are the driving force behind such plans. Unfortunately, long-term plans tend not to consider options for demand management as a viable alternative for increasing the supply, and this seems to be the case in the NHP.

Short-term reductions during times of shortage provide a margin of safety, a buffer, and a substitute for higher supply reliability. No service is 100% reliable, nor should it be. Providing the last few percentage points of reliability increases the cost of the supply system exponentially, and therefore the optimal level of reliability provided is always somewhat less than 100%. How much less it should be depends on the consequences of shortage. Since a considerable portion of the quantities to be transferred from the Lower Ebro are for agricultural uses, this creates a natural buffer that can and should be used as one measure for increasing the reliability of urban water supply. In other words, when there is shortage, there are uses that can be curtailed in order to avoid or minimize a reduction in supply to the urban users. This entails economic losses, and may result in political turmoil, and still the flexibility of agriculture to absorb temporary curtailment need to be used.

We find in the opening "Statement of Purpose" of the NHP: *"Some of the aspects which warrant mention because of their special nature are the effective management of water supply, the requirement for maximum effectiveness in resource management in the receiving basins, the regulation of hydrological reserves for environmental reasons, drought management and flood zone regulation, groundwater protection and wetland conservation, and measures aimed at raising awareness, training and education in sustainable water use."* Further in the NHP there are additional statements regarding the actions that must be taken in the receiving area to demonstrate efficiency in the existing uses and justification for the water to be received by transfer.

There are, however, no specifics how these measures might be achieved, nor the level to which they will be applied. Without giving specific targets for efficient use, while at the same time mandating specified quantities for transfer, this is a recipe for focusing the entire attention on the transfers, and reducing attention afforded to demand management options. Even though the transfer amounts are stated as being a maximum (*an annual volume of <u>up to</u> x hm^3"*) the facilities for transfer will have to be built for this maximum, the entire investment made at the time of construction, which provides a strong incentive to use the facility to capacity. (It is concerning to note that previous transfer projects constructed in this region have <u>not</u> been fully utilized, some never used fully since they were constructed, which indicates a waste of resources.)

A 10% reduction in urban demand is achievable when the current level is over 110-120 m^3/cap/year. This includes two levels of urban water management:

1. Reduction of water consumption in the household, achieved through the introduction of technologies (low flush toilets; constrictors on taps; later, and with more investment water-efficient washing machines; efficient irrigation in gardens)
2. Reduction in "unaccounted for" water in the urban system. Most Israeli cities have reached values below 15%, and the AWWA reported recently that US cities are approaching similar results. Care must be taken when reviewing the figures for "unaccounted for". They usually include two principal components: (a) actual physical loss of water from the hydraulic system, due to leaks, and (b) water that is used but not metered, including for fire fighting, flushing pipes, sometimes for public gardens and parks, etc. Both these can be addressed through technical and administrative management schemes.

The NHP should have been more explicit regarding demand management for the urban area and provided *specific quantitative efficiency targets to be achieved* (although this may have been done in adjoining documents that I have not seen). There are several means for influencing domestic and urban demands:

- Technology: reduction of losses and unaccounted-for water in the municipal systems; low-flush toilets, tap-constrictors and similar devices in households; efficient irrigation of private and public gardens. This must be a long-term effort, whose benefits are realized slowly but steadily. Introducing water-saving technologies into existing urban areas, i.e. retrofitting, is a complex matter. Still, some measures are feasible, such as replacement of toilets and flushing mechanisms over a period of years, through regulations and economic incentives.
- Pricing: the elasticity of urban water consumption has been found in several studies to be in the order of –0.3, which means that an increase in the price of 10% will reduce consumption by 3%. This figure can be used at the current level of consumption, and it decreases as the price rises, so that a 10% increase in price at those levels will cause a reduction of less than 3%. There is some evidence that consumption bounces partially back after the initial shock of the price increase, and still there is a residual effect on consumption.
- Education: this is another long-term measure that can be most effective when it is begun at an early age and covers the entire population, using different means to reach different segments. An important element is public participation in a policy and action plan for sustainable development, which can influence other areas of public service, such as transportation and energy.

- Law and regulations: These provide the means by which the authorities impose restrictions and conditions on the behavior of individuals and lower authorities, to use technologies, pricing and educational means. My attitude is that incentives are better than regulations. The former have a much better chance of being implemented since they mobilize the will of citizens and do not require enforcement. Regulations are always difficult to enforce, they require administration complexity and cost, and end up in yet another scramble between the authorities and citizens.

Leakage control can be achieved through better management of the system: lowering operational pressures and detection and fixing of leaks. There are estimates that the total amount of accounted for water in the urban areas of coastal Spain are in the order of up to 30%, of which about one half is physical loss through leakage and the other half comprised of un-metered uses. The latter are not real losses, but still they should be largely curtailed through better supervision and enforcement.

As an illustration, the forecasted populations of Barcelona and Valencia in 2020 are estimated at 6.484 million (down from 6.772 million in 1999, a reduction of over 4%). At the demand levels quoted above this population would require between 713 and 804 hm^3/year. A reduction of 10% would mean 70-80 hm^3/year.

These figures relate to Barcelona and Valencia alone, the main target urban consumption areas for the transfers. Similar reductions can be achieved in the other target urban areas. The opportunities for saving are greatest in large urban areas, where the water authorities have the capacity to implement such programs. But even in smaller communities, of tens to hundreds of thousands of inhabitants, savings of 10% are possible and worth pursuing.

In conclusion, the NHP itself does not contain adequate and specific attention to demand management options in the urban sector. And even if such stipulations are covered by other documents, the fact that they are not mandated as conditions that have to be met prior to approval of transfers means that there may be neglected.

Desalination

Israel has recently launched a major program of seawater desalination, combined with other elements of a national interim plan for the years 2002-2010: desalination of brackish groundwater, reclamation and reuse of wastewater, import from Turkey. The development of desalination over this period is to reach a total production of 400 hm^3/year, from a series of 6 large plants along the coast of the Mediterranean Sea.

The plants will range in size from 45 to 100 hm^3/year, and will include the largest Sea-Water Reverse Osmosis plants anywhere. They will be built by private interests under BOO and BOOT contracts with the Government, except one 45 hm^3/year plant, which will be a Turnkey contract with Mekorot, the National Water Supply Company.

The first tender, for a 50 hm^3/year plant in Ashkelon, attracted most major international companies, who were required to link with local companies in a consortium. The contracted price of water at the plant is 52.4 US cents/m^3. This lowest price anywhere in the world has become the criterion for the following contracts. The plan for the first plant has been expanded to 100 hm^3/year, and additional ones have already been contracted with other consortia. The price to be paid at other plants will be in the same order, although there are some adjustments due to local conditions. The Ashkelon plant will be fed by an 80 MW power plant constructed by the consortium. The flat power requirements of a desalination plant make it attractive to supply energy from a dedicated power plant.

Water costs at the plant will range between about 50 US¢/m^3 at the large plants and 55 US¢/m^3 at the smaller ones. These figures can be used as a benchmark of realistic prices for desalinated seawater at the plant. Obviously, the cost of getting the water into the conveyance system and to the customers must be added.

The quality of the product water will be very high – less than 80 ppm chloride and 0.4 ppm boron (important in irrigation of crops). This is an attractive aspect of the desalinated water as it can improve the quality in the system through blending with the natural waters, but care must be taken to consider the chemical qualities of the blend and its effect on the system and on consumers.

The total cost of Israel's 2002-2010 Development Program, including desalination and the other components, is estimated at more than 4 billion US$. The burden of financing will be shared by the private and public sectors. The plan provides opportunities for employment and for strengthening an export industry.

The cost of desalinated water transported to consumer areas depends on the distance from the desalination plant and the elevation difference against which the water must be lifted. For the large cities on the coast, Barcelona and Valencia, this additional cost is small, and probably comparable to the cost of getting additional water from the existing close-by sources. For a location further inland, the cost will include the pro-rated investment cost for the transfer pipe and the energy cost.

For a location at a distance of 100 km from the coast and at elevation 500 m. the cost of transport, including investment and operating costs, is in the order of 0.2-0.25 Euro/m^3.

Reuse of Treated Wastewater

There is a substantial potential for reuse of reclaimed wastewater. As urban use grows there is more wastewater to be reclaimed. Alternative disposal options for the wastewater are vanishing, as environmental regulations on land and sea are tightened, and reuse is therefore becoming a more attractive option. Recovery of 50% or more of the urban water use is an ambitious goal, and entails substantial expenditures, as well as technical and managerial capacity. Still, this is an achievable goal, one that can be carried out gradually, as water consumption rises and more wastewater is produced.

As before, I have not found adequate specific plans for developing this source. Again, this may be stipulated in other plans and documents, but if this is not made a condition to be met before transfers are considered then it is to be expected that reuse may not be given the boost that it deserves.

While reuse can and should be an important component in the overall balance between demand and supply, careful attention must be given to the level of treatment for each type of use. Conventional treatment removes organics and microorganisms, but leaves salinity, and can remove heavy metals and other contaminants only if it is carefully designed to do so (at an increased cost). Reuse of treated effluents with high salinity will cause soil salination, crop reduction and losses.

Nowadays, membrane processes are used to remove damaging constituents from the effluents after the stages of conventional treatment. The increased cost should be weighed against the reduced losses resulting from the use of effluents without these advanced treatment stages.

Management of Groundwater Aquifers

Spain has much expertise in groundwater hydrology, but there is evidence that overall the country has not been making optimal use of its groundwater resources.

There are many cases of good local management of groundwater in Spain, and yet the role of groundwater is not utilized fully at the national scale. Groundwater development has many advantages, some of which are:

- It is distributed in space, and there are frequently opportunities to develop it close to the demand area;
- It can be developed gradually, as the demand rises;

- Aquifers have large storage, which provides a buffer to smooth hydrological variations;
- Their hydrological response is slow, so when there is shortage on the surface the groundwater may still be plentiful (if it is managed properly and allowed to build back up during years of high surface flows);
- It provides the possibility of mixing of waters of lower quality into a large water body (again, as long as this is done judiciously) to increase the total amount of water available.

But management of groundwater requires ability to oversee the actions of many persons in diverse geographical and administrative domains, a difficult matter under any circumstances. Historically, groundwater in Spain was under private control, so there is a tradition of use, but less of coordinated management.

My overall impression from examining the NHP and the additional documents listed in the Appendix is that the role of groundwater is not adequately stressed. A few comments regarding the manner in which groundwater management is treated in the NHP:

- Allocations from the aquifers seem to be defined as fixed quantities, apparently based on *average annual potentials.* If so, how is variability of recharge and yield taken into consideration? This matter is addressed in the law to some extent in the following sections, by setting lower limits on the remaining flows. But as long as there is that minimum in the river then the transfer can take all the rest.
- Article 8(2): Power of adjudication over management of shared aquifers – when there is no agreement between the parties - is given the Ministry of the Environment. Do they have or will they have the capacity (technical, administrative, managerial, financial) to be able to control these matters? Groundwater hydrology tends to be controversial in its assessments of existing situations, and even more so of the effects of various management schemes.
- Article 8(3): Groundwater flow between territories is not governed by the Act. What if Basin A pumps hard, causes drawdown and more flow into its territory from Basin B? Is this controlled? If not, it may be a cause for future conflicts that cannot be resolved under the Act. This is a typical case of the "Tragedy of the Commons" Consider the example of Mexico and the US on the Colorado: lack of control over groundwater caused such actions (excessive drawdown) and a conflict.

Llamas [2002] provides a thorough analysis of the past and current situation in groundwater development and management in Spain. I am quite aware that Llamas is viewed by some as extreme in his criticism, but I have followed his work for many years and my impression has been that his position is basically sound: the role of groundwater at the regional and national levels is not adequately explored. By the way, this situation can to be found in many

other parts of the world (although not so in Israel). Groundwater is “the hidden resource”, not well understood and therefore neglected. A cynical perspective is that a hundred wells do not create the same opportunity for politicians to “cut a ribbon” as a dam or a large water transfer system, and it is for this reason that politicians prefer large projects. The public, too, often tends to prefer what appears as a conclusive response to water shortage, in the form of a dramatic “major project”.

Responsible governments should, however, not take this route, and instead combine many small steps into the development plan, together with the “mega projects”. This will be addressed below in section 3 of “Other Concerns”.

Joint Management of Supplies to Urban and Agricultural Consumers

Urban water demand is by nature more rigid than the requirements for irrigation. When there is shortage, people come before crops that are not essential for human existence. This means that the *reliability* with which water is supplied to farmers can be considerably lower than for cities. As an illustration, urban water supply is planned to yield at least 80 to 90% of the normal supply with a reliability of 98-99% (failure once in 50 to 100 years), while agricultural supply can be planned with a lower reliability, say 90% (one in 10 years). Since the quantities for irrigation are large, joint management of supplies to urban and agricultural supplies which exploits this difference provides an opportunity for flexibility and decrease of the planned supply facilities.

The concept is simple: design the urban supply for 1:N years (on the average one shortage every N years) and irrigation supply for 1:M years (M<N). Reduce the supply to farmers in those years when there is shortage to the point where the urban demand can be met, while meeting jointly the two different reliabilities. The main concept is that the more flexible (irrigation) allocations constitute a *buffer* for the more rigid (urban) demands.

The amount to be curtailed from farmers need not be a fixed quantity. It should depend on the specific conditions that prevail when there is a shortage.

This scheme must include compensation to farmers who receive less than the normal quota. Calculating the level of compensation is not a trivial matter, and is expected to be fraught with pressures and political wrangling. Still, if the scheme is designed in advance, when the plan is implemented and not when a crisis hits, then it should be possible to include this component into the overall scheme. An insurance-like mechanism is incorporated into the plan, which allows the authorities to decide when to implement the transfer of

water from irrigation allocations to the cities and how to compute the compensation.

Another mode for implementing the same philosophy is to buy back water allocated to farmers when there is a shortage. In this approach, a price schedule is declared, and adjusted until the amount so purchased fills the shortage to the cities.

Obviously, the scheme is viable only if the expected value of the compensation stream to be paid for withholding water and/or buying back allocations is less than the savings accrued to the plan by reducing the demands imposed on it in drought years.

This approach has been the operating mode of the Israeli water system for a few decades. Water allocations are re-issued annually by the Water Commissioner, who has the authority to adjust them according to the hydrological condition.

In California, partial water markets have had some success. Cities have purchased water from farmers, either on a permanent or temporary basis. For example, cities have invested in measures that improve the efficiency of irrigation systems, under an agreement that gives them the water that was saved. Canals have been lined to reduce losses, which then decreased the amounts taken by the irrigation systems, providing extra water to the city.

There are several caveats to be considered:

- There are short-term and long-term versions of these measures. Short-term measures operate under conditions of shortage and are meant for the year in which there is shortage. Long-term measures allow for various forms of arrangements in which cities can get a larger share through arrangements with farmers, either voluntary or mandated.
- The process must be embedded in the water resources plan explicitly and in advance, so one can depend on it and not face the danger of being thwarted by political pressures when it is implemented.
- With time urban demands will grow and become a larger proportion of the total supply, while agricultural uses tend to reduced, which decreases the flexibility and reliability afforded by the procedure. However, this is the normal development and when this happens it is anyhow time to consider the next increment of supply.

The decreased size of the transfer scheme and the more flexible operation over the years can result in substantial reduction in cost and disruption at the source locations, and should have been considered in the NHP. It is not possible to estimate the reduction in size and cost in a generic manner, since it depends very much on the legal, administrative and financial arrangements that are made with the consumers.

Other Concerns

1. Complexity of the management structure and mechanisms

A main question I have with respect to the NHP is: will the organizational and institutional structure be able to implement effectively the NHP. Are there the technical, organizational, administrative, managerial and financial resources required to accomplish an effective implementation?

This concern comes from noting the large number of bodies involved, and the absence of clear lines of control and capability to implement. The bodies that are mentioned in the Act are (and I am not sure I caught them all!):

- Ministry of the Environment.
- Council of Ministers.
- Basin Boards ("boards of the basins" are mentioned only once, in Article 16(3), and this should have been corrected to "Basin Boards" to avoid any possibility of confusion). Are they the authorities who develop and issue the "Basin Body Plans"? Who has to approve these plans?
- Central Users' Boards [Article 19(1)].
- Exploitation Boards [Article 19(2)].
- Hydro Authorities: what are they? To whom do they answer? It seems [from Article 17(5)] that these are the Boards of inter-community basins; but it is not clear what "inter-community" means.
- "Public Authorities" are mentioned several times (e.g., 2nd paragraph on page 2); this seems to be a general term relating to <u>all</u> authorities that have a say in water management. Correct?
- "Communities" and "user groupings" are mentioned in Article 17(6).
- "Central Users' Board" [Article 18(1)] for each recipient basin.
- A "Transfer Committee" shall be set up, which shall represent, in the manner legally determined, the Ministry of the Environment, the Hydro Authorities or Management Bodies of basins involved as basins of origin, recipient or transit basins, the Central Users' Boards or equivalent bodies of transferred waters, the Autonomous Communities affected and the non-consumer users of specific reservoirs referred to in article 16.2.c), and the Deputy Vice-President of the Board of the basin of origin, representing the users. [Article 19(1)].
- The "Director General of Hydro Works and Water Quality" authorizes the conditions under which the transfers are effected, and their volume. [Article 19(2)], except when the "Transfer Committee" reaches its decision unanimously.
- "General State Authority" [Article 22(4) and (10)].

- "National Tax Authority" [Article 22(8)].
- "General State Authority" [Article 22(4)].
- Autonomous Communities and organizations representing Local Corporations [Article (23(2)].
- "National Water Council" [Article 35(2)] – may propose criteria for updating the review of the implementation of the NHP and the Basin Plans.
- "An organisation shall be set up under the chairmanship of the Generalitat de Cataluña, made up of all the Authorities and bodies with powers to act in the area of the Ebro Delta: the Ministry of the Environment, the Generalitat de Cataluña, Local Bodies, as well as user bodies and social organizations." – Supplementary Provision Ten(2). This is to be done within one year – has it been done?
- To Article 6 (Criteria): "An organisation shall be set up under the chairmanship of the Generalitat de Cataluña, made up of all the Authorities and bodies with powers to act in the area of the Ebro Delta: the Ministry of the Environment, the Generalitat de Cataluña, Local Bodies, as well as user bodies and social organizations." – Supplementary Provision Ten (2). This is to be done within one year – has it been done?
- These are termed "coordination criteria" but in effect look like specific instructions for the basin plans.
- There is a 2-year delay in issuing criteria. What will be in the meantime?
- The list of criteria does not include: development of alternative sources, demand management, hydropower.

2. The Ebro Transfer Presented as the National Hydrological Plan

The law of 5th July 2001 is "concerning the National Hydrological Plan", but it deals exclusively with transfers from the Lower Ebro river. Article 4 states that *"This Act shall apply to the entire national territory notwithstanding any measures that, because of their nature, may be required to act exclusively on specific territorial areas…" .* One wonders why a plan that relates exclusively to a specific region is titled "National Plan".

Article 13 specifies the *maximum annual quantities* that are authorized for several components of the transfers, namely:

- Up to 190 hm^3/year to the Catalonia Inland Basins;
- Up to 315 hm^3/year to the Jucar Basin;
- Up to 450 hm^3/year to the Segura Basin;
- Up to 95 hm^3/year to the Southern Basin;

- A total of up to 1050 hm^3/year

Article 14 allows authorization of additional "small" transfers between basins: the Ministry of the Environment up to 1 hm^3/year and the Council of Ministers up to 5 hm^3/year. Thus the NHP is limited mainly to the Ebro transfers.

From my knowledge of the water resources situation in Spain, although incomplete, I am aware that there are other regions of the country whose water resources management could benefit from a plan that exceeds the local administrative boundaries. Thus I expected that the title "national plan" would include a scope much beyond the Ebro transfers and the related water sources in the area. Was the title *"national"* given to the plan so as to allow the national authorities a decisive role in mandating the plan and making operational decisions (see my list of bodies involved, in 1 above), something that they could not do under the regular division of jurisdiction over water resources?

3. Performance of Previous Large Transfer Projects and the Value of Small Development Increments

It is quite amazing to see the low performance of previous transfer projects in this region. It leads one to ask whether the Spanish Government has provided an explanation why, in view of the fact that these projects have been utilized so partially, it does not deem these large-scale projects as a poor choice. It may be typical of the approach that central authorities tend to take, namely to go for large ambitious projects that have high visibility and are supposed to solve problems "in a big way", rather than the less dramatic but more effective approach of using many small steps.

The approach of incorporating smaller projects and timing the large ones only when there is certainty about their necessity provides several notable advantages:

- The cost of water is better controlled and is often lower. In the first years of operating a large project, when its capacity is yet not fully utilized, the cost of water is actually much greater than the average cost over the project's entire life time. The full investment cost has been expended (or almost all of it, if additional components, such as an expanded pumping capacity, is to be added at a later stage) while the benefit has not been developed yet. So the unit cost of water to the national economy is in fact larger than the calculated average. Furthermore, if the flows never reach the planned level – as has already happened in some cases - then the true cost of water is above that which has been computed at the planning phase.
- A development plan which contains many smaller components can be adjusted to changes in conditions that occur over time, changes which cannot be forecasted ahead of time. An example is the adjustment to unforeseen development in the demands and in the economic

conditions that drive them. Planners of large projects tend to overestimate future demands.

- Failures are limited to the smaller scope of individual projects and measures. One or even more failed wells in a groundwater exploitation program may cause some local distress, but is nothing compared to the magnitude of the engineering, environmental and financial losses than can be incurred by even partial failure in a large mega-project.
- Public participation is enhanced when small local projects are developed. The project can be adjusted to local concerns about the environment, about costs, about management structures. In this age, publics can be a positive force in driving development, but they can also be a major hindrance when they mobilize against the project.

3. National versus Regional Perspective

The NHP is predicated on the policy that all regions in Spain are integral parts of one geo-political unit, with mutual responsibility. This implicit philosophy, which is not spelled out in the NHP but is clearly its foundation, is presumably the basis of the general Spanish political ethos. Even so, questions can and should be raised whether it justifies a plan that goes in the direction of removing benefits from one region to provide them to another.

I have not seen in the NHP itself an assessment of all the potential losses to those uses from which water is to be taken, weighed against benefits that will accrue to those who will receive it. Such a balance sheet would have helped in assessing the viability and efficacy of alternative means for providing the proposed benefits

4. Cost Recovery

Article 13(3) stipulates that the transfers envisaged in the Act are subject to the principle of *cost recovery in accordance with the principles of the Water Resources Act and Community Regulations.* Not being familiar with these laws and rules I am unable to evaluate what this means. Logic would indicate that the consumers whose demand is to be met by the transfers are expected to cover the cost. Is this the case, and, if so, <u>when</u> are they expected to cover the cost – over what period of time.

Appendix: Materials reviewed

The Offfice of the Head of State: 13042 ACT 10/2001, of 5th July, concerning the National Hydrological Plan

And:

[1] Draizin, Josef and Zaide, Miki (2002) Israel's 8-Year Desalination Plan, Israel Water Commission, Planning Division

[2] Gobierno de Aragon (2000)

[a] General submissions and considerations by the Government of Aragon with respect to the Document presented by the Ministry of the Environment to the National Water Council on 5th September 2000 under the title of "The National Hydrological Plan";

[b] La desalacion y reutilizacion como recursos alternatives;

[c] Informes relevantes para la elaboracion y aprobacion de las alegaciones del Gobierno de Aragon al anteproyecto de ley del Plan Hirologico Nacional;

[d] Complaint of Breach of Community Law in act 10/2001 of 5th July, concerning the National Hydrological Plan, presented by the Government of the Autonomous Community of Aragon (Spain);

[e] La rentabilidad del regadio en el Levante ante nuevos recursos hidricos externos;

[f] El Plan Nacional Hidrologico a debate – Pedro Arrojo Aguso (coord.) – a collection of 42 papers by various authors.

[g] Water Demand Alternatives to the Spanish National Hydrologic Plan – Executive Summary.

[h] La Energia del Travase – by CIRCE and the Universidad de Zaragoza.

[3] Hoffman, Daniel and Zfati, Amnon (2001) Hybrid Desalination Systems: Effective Integration of Membrane/Thermal Desalination and Power Technology, Research Report, Middle East Desalination Research Center (MEDRC) Contract 98-R-001 Research Report.

[4] Llamas, M. Ramón (2002) Lessons Learnt from the Impact of the Neglected Role of Groundwater in Spain's Water Policy, Department of

Geodinamics, Complutense University, 28040 Madrid, Spain (paper presented at a conference).

[5] Embid Irujo, A. Economic-Financial Framework of the Ebro Basin Transfer in Act 10/2001 of 5th July, Concerning the National Hydrological Plan, and Thoughts on the Economic-Financial Aspects of Basin Transfers in General.