

SURFACE WATER WITHDRAWAL PERMITS PROGRAMS FOR HUMID REGIONS

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Abstract. In humid regions of the eastern United States, rainfalls and streamflows have usually been sufficient to supply nearly all human needs. In those states a set of common-law precedents known as the riparian doctrine has evolved. This doctrine is rather imprecise compared to the appropriative doctrine of the western states. In recent years, problems of concentrated use have become more common and severe in humid regions, leading to calls for water regulations. There are a number of options for such regulations; this paper provides a comparison of alternatives in the context of six program objectives and a number of agency decisions.

The first program objective is the ease of setting up the program initially (implementation), operating it routinely (administration), and insuring compliance with it (enforcement). The second is maintaining equity, or the perception thereof, among water users. The third is to maintain minimum streamflows. The fourth is robustness, or insensitivity to errors in the data. The fifth is economic efficiency. The final objective is political and legal feasibility.

The first agency decision is what the permit should entitle its holder to do and under what circumstances. An operational definition of a permit must say where, and for how long, the water may be withdrawn and what happens when there is not enough water to supply all users. Options for permit structure are: 1) no regulations, 2) prioritized permits like those used in the West, and 3) fractional permits, in which users' allowable withdrawals increase and decrease with streamflow. Only the latter, fractional permits, are seen as appropriate for traditionally riparian regions.

Another agency decision is on what basis permits should be distributed initially. Size allocations could be roughly proportional to some measure of past use rate or current size of operation (e.g., hectares irrigated or population served) with provisions to dissuade profligate use just to receive a higher allocation.

Another decision is whether or not permits should be transferable and, if so, under what circumstances or restrictions, etc. The most frequently-cited argument in favor of allowing users to transfer permits is economic efficiency.

The chief drawbacks of transfers are that local streamflow standards could be violated and third parties could be impaired.

Other agency decisions include the duration of permits and their averaging periods.

INTRODUCTION

In the humid regions of the eastern United States, rainfalls and streamflows have usually been sufficient to supply nearly all human needs. In those states a set of common-law precedents known as the riparian doctrine has evolved to govern water use. This doctrine is rather imprecise compared to the appropriative doctrine of the western states and many riparian states lack a strong, comprehensive, set of water use regulations. In recent years, however, problems of concentrated use have become more common and severe in humid regions. Aquifer levels and aquatic stream habitats have been threatened by concentrated withdrawals as cities have expanded, and highly consumptive irrigation has increased in use. While discussion of comprehensive management programs has occurred (e.g., Mack and Peralta, 1987), implementation has not been widespread.

It is assumed here that a water management agency or ministry (referred to as the agency) has been charged with developing and administering a water withdrawal permit program. Each user receives a permit allowing a rate of withdrawal that depends, generally, on ambient (streamflow) conditions. A set of target minimum streamflows for protection of the aquatic ecosystem is assumed already set. The difference between this minimum and the streamflow at any point is the total allowable withdrawal, or TAW.

The agency is assumed to have the legal authority to regulate withdrawals and is assumed to be searching for the most effective way to craft a permit system to control withdrawals by offstream users. In doing so, it has a myriad of decisions to make and, in making those decisions, is attempting to balance six objectives. The objectives and decisions are discussed below.

AGENCY OBJECTIVES

The agency is assumed to pursue six objectives. The first is to maximize the ease on its part in setting up the program initially (implementation), operating it routinely (administration), and insuring compliance with it (enforcement). This is an important feature of, and indeed the essential purpose of, the permits program. Ideally, the program should insure the smooth functioning of the distribution of water, including disputes among users, without resort to the courts.

The second objective is maintaining equity among water users. Equity is very much in the eye of the beholder, and the decision about what is equitable or inequitable is arbitrary to some extent. However, some program features are more universally accepted as equitable than others. An example is the principle of allocating permit sizes in rough proportion to the user's size. While there may be argument on which measure of size should be used, there will be greater agreement that allocation in proportion to some measure of size is more equitable than equal size allocation to all users, great and small.

The third objective is that for the program is originally devised, viz., to maintain streamflows. If minimum stream-flow requirements vary throughout the year, this may add complexity to the permit definition.

The fourth objective is that the social benefit of the program be robust, or insensitive, to errors in the data upon which its design and operation depend. In planning the permit program, there will necessarily be errors in measuring parameter values upon which the program design depend. To the extent possible, the program should be designed to minimize the dependence of its smooth functioning on the values of those parameters.

The fifth objective is to maximize economic efficiency, i.e., the economic benefit of the water in use. This could conceivably be accomplished by clever allocation, but may be served at lower administrative cost simply by allowing voluntary permit transfers among users.

The final objective is political and legal feasibility. Regardless of how well a permit system performs its functions, it won't be accepted unless it meets political muster.

AGENCY DECISIONS

Definition Basis

The agency must first decide what the permit should entitle its holder to do under what circumstances. It is often convenient to think of it as entitling its holder to withdraw a certain volumetric flow rate (e.g., liters per minute) of water,

but the complexity of stream systems may require a more detailed operational definition. Such a definition must be more complete and must say where water may be withdrawn and what happens when there is not enough water to supply all permits. Options are:

No Regulations The absence of regulations means that water is most available to whoever takes it first, where "first" does not necessarily mean first in time, as under the western appropriative system. Indeed, "first" might mean just upstream of another user, and in a position to deprive him or her of all water. Hence, one sound argument for water regulations is the protection of current water users.

Prioritized Permit Basis Under the prioritized basis a set of priorities is established whereby a user is allowed a certain fixed rate of water withdrawal as long as the TAW is enough to satisfy him or her and all other users with a higher priority. When it is not, users forego withdrawals according to their priorities. This basis is used under the appropriative doctrine in the western U.S., where such priorities have been set according to the date of first request for the water permit or first use of water by the user. It has proved functional there, but cannot be adapted to humid regions because of the difficulty of establishing these temporal priorities among users whose undocumented withdrawals may have existed for decades or well over a century.

Fractional Permit Basis Under the fractional basis of definition, each user is allotted a constant, but generally different, percentage of the TAW. Thus, as the TAW fluctuates, so does the amount of water allotted to each user; no user is ever entirely deprived of water. Under this basis, no permit has priority over another, although they may differ in size. The fractional permit basis is often regarded as the only appropriate approach for humid regions because of the lack of data by which to establish historically-based priorities among users. There may, however, be some perceived equity and administrative disadvantages to this basis. First, there is no easy way to issue free permits to newcomers, although they may buy their way in and may be accommodated through staggered limited-duration permits (see below). By contrast, the prioritized permit basis may be structured to accommodate newcomers by assigning them lowest priority. The second disadvantage is that it is more difficult to account for the geometric complexity of real river systems under this type of permit definition basis. This problem, which is too complex to explore fully here, stems from the oft-perceived need for fractional permits, unlike prioritized permits, to refer to a particular stream gauge. Ways of addressing this problem also exist, but are too complex to discuss here.

Allocation Basis

The agency must decide the basis for distributing the permits among the users, i.e., deciding the rate of allowable withdrawal or the fraction of the TAW the user is allowed to withdraw. In the past in appropriative states, allocations to users were based on user claims or the agency's judgment about the amount of water each user "needed." The potential for equity challenges to this approach in humid areas is obvious, especially as temporal priorities are difficult to establish.

Allocations in humid areas could be roughly proportional to some measure of past use rate. Provisions could and should be incorporated to avoid rewarding those who had used water wastefully in the past, and certainly to dissuade users from profligate use in the present for the sole purpose of receiving a higher allocation in the future. This poses the problem of estimating past withdrawal rates that may have been unmeasured.

Alternatively, the size of a fractional permit might be proportional to a measure of the size of an operation such as the length of riparian streamfront, the area of riparian irrigated land, or the population served by a municipal water supplier.

Voluntary Permit Transfers

Voluntary transfers (i.e., buying and selling) of water permits among users may be allowed within limited lengths of the stream. The most frequently-cited argument in favor of this feature is economic efficiency (see, e.g., Anderson, 1983 a&b; Eheart and Lyon, 1983). Transfers also provide an incentive to develop and adopt ways of using water more efficiently, through recycling and waste reduction (Anderson, 1983b). Transfers have received endorsements from many policy analysts (Johnson et al, 1981; Stavins, 1989). The additional administrative costs of transfers are expected to be modest; the agency must maintain a registry of permits and transfer restrictions must be decided upon and administered. No cost data need be collected, however, and no cost optimization need be done (at least, not by the agency). The agency may *opt* to set up a brokering operation, but transfers are generally voluntary and need not be brokered at all.

The chief drawback of this policy is that, through an unfavorable set of transfers, concentrated withdrawals might occur, rendering it more difficult to maintain stream flow standards near such points of concentration. Additionally, under these circumstances, the neighbors of a permit buyer may be impaired and the neighbors of the seller may receive a windfall benefit (Eheart and Lyon, 1983).

This problem may be addressed by limiting trading to users who have approximately the same effect on the streamflow. Alternatively, permits may be otherwise altered as they are transferred so as not to impact minimum flows or

third parties. A third approach is to require compensation to third parties.

Transfer restrictions may undermine efficiency gains and may not be effective in protecting third parties anyway. Third party compensation has been endorsed by some researchers (e.g., Coase, 1960). Others (e.g., Baumol and Oates, 1988) note potential problems of strategic behavior if third parties are given final authority on whether a transfer is allowed. Another potential drawback of transfers is that, because of the usually small number of participants, one or a few parties may be able to manipulate the permits market to their advantage.

Duration of Permits and Accommodation of Newcomers.

The agency faces a dilemma in deciding the length of time a permit is valid. As noted by Eheart and Lyon (1983), permits that are valid for only a short time may not allow the users sufficient time to pay off capital equipment and may thus result in economically inefficient decisions. (For example, the user may purchase less expensive equipment that uses water inefficiently.) A long permit validity will present difficulty in accommodating newcomers, and a risk of violating minimum flows. One way of addressing this dilemma is a system of staggered permits of n-year duration under which the agency may lower the total number of permits by as much as $1/n$ per year simply by not reissuing expired permits.

Averaging Periods. It is not possible for water users to restrict their withdrawals to a certain flowrate at all times, nor is it always desirable from the agency's perspective for them to do so. Crops need only be irrigated when they undergo moisture deficit, and municipal demands fluctuate according to the weather and the incidence of fire. It is therefore appropriate for the agency to grant users some flexibility by restricting their time-averaged, rather than their instantaneous, withdrawals. The question then becomes one of choosing the averaging period. The larger the averaging period, the more flexibility the users have but the greater the opportunity exists for them to overexploit the water resource, if only temporarily. Averaging periods will range from days for unimpounded streams to years for aquifers.

SUMMARY

In choosing a system of rules for administering water withdrawals, the agency faces a bewildering array of decisions and tradeoffs. In regions where water using economic activities are well established, it is unlikely that anything but a system of sharing will be politically acceptable. Permit transfers are a feature that will probably find favor among users and the agency will be under some

pressure to undertake the administrative cost to implement them. Key to the operation of any such program is the existence of an adequate system of stream gauges and streamflow record keeping.

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