## 8.13 Exercises

1. Through her own production activities, water user G has been maximizing utilization of her 50 units of water rights, because no other options have been available. Now, after a recent institutional revision allowing water right transferability, user M has approached G with an offer to lease as much as G can offer at $100 per unit. With the assistance of a graphic, explain to G what she should do to maximize her income and indicate how you could calculate G's net gains from this action (if she does anything different). Include attention to your graphics (and other tools as appropriate) in your explanation.

2. What's the equivalent single price of an appliance rebate program having the following character? When a consumer buys a qualifying "high efficiency" washing machine, the city will pay the buyer $50 immediately; water savings are expected to be 600 gallons per year per appliance for 10 years. The city has $10,000 to allocate to this program, and it expects that this money will be claimed quickly. The discount rate is 4%. Expectations are that one-half of this money will go to people who would have purchased a high efficiency model without the rebate. The city utility wants you to compute this ESP so it can be compared to the ESPs of other available water policies.

3. Suppose linear MNBs for two agents, as depicted in figure 8.1. Suppose that these natural water demands are specified by

$$MNB_1 = b_1 - m_1 w_1 \quad \text{and} \quad MNB_2 = b_2 - m_2 w_2 \ ,$$

together with $(b_1,b_2,m_1,m_2) = (32,25,1,0.5)$. Water units are megaliters (ML) per year, and monetary units are dollars. Additionally, agent 1 owns twenty ML and agent 2 owns fifty ML of water rights. Assuming no other agents, what is the optimal amount of water for one of these agents to lease to the other? Except for the financial terms of the lease, what value does the seller lose and what value does the buyer gain? Illustrate these results by drawing a replication of figure 8.1 that is reasonably accurate for the data of this problem. What are the net (aggregated) gains? If this water is leased on a per megaliter basis, what range of prices might be used? What price equilibrates MNBs? Using the latter value, a discount rate of 10 percent, and assuming all conditions to be steady over time, what is the market value of a permanently transferred megaliter? How much money might each agent be willing to pay their separate attorneys to guide a permanent exchange through the state-run approval process?

4. Completely quantify and describe a proposed trade of surface water between two ordinary diverters, both with return flows of 50%, where this trade would benefit streamflow along a particular river segment. (Include sufficient quantitative detail to indicate that this trade would add a certain amount to the segment's streamflow.) How is it that this situation qualifies as a market failure and what type (name it) of market failure is this? Describe a policy remedy and explain how it corrects the market failure.

5. You are an irrigation district manager who has assembled some information on demand and supply within your system. You believe retail demand this coming year will be $w = 95005p^{-0.8}$, and your total operating costs will be $C = 7.2\times10^{4} + 8.23\times10^{-9}w^{3}$. Both of these functions are expressed in units of natural water. What is the maximum

amount you should be willing to pay for a four thousand unit lease if you already have rights to sixteen thousand units?

6. In recent years water lease prices have been rising 3 percent annually even though inflation has only been 1 percent. Presently, a water right to a hundred acre feet can rented for $7,000. Given this information, compute and explain a sales price for a one hundred acre foot right. Use a 6 percent real rate of discount and a twelve-year planning horizon. Repeat the computation for an infinite planning horizon.

7. Compute the equivalent single price of conserved water for phase 2 of the canal rehabilitation project in chapter 7's exercise 5. In this phase, assume that Kettle Irrigation District pays $1.2 million in year 2 for the specified schedule of future water savings.

8. During the next three years, the City's new reservoir should fill to contain enough water to handle foreseeable demand. During these three years, an interim measure is desired. The City has two take-it-or-leave-it options. Each is adequate, so only one measure should be selected.

In measure A, a company is contracted to repair leaks. The cost will be $500,000 in year 1. No other costs will occur. The three-year schedule of water saved (water supply impact) will be 30, 90, and 90 units of water, respectively.

In measure B, a downsizing farmer has offered a three-year lease. Payments for B will be $90,000, $200,000, and $210,000 respectively in the three years while the water supply impact will be 40, 70, and 90 units.

Any surplus water from either measure can be sold at cost to suburb utilities that buy water from the City. Is A or B the better deal given a reasonable discount rate?

9. As the state water agency employee designated to work with and advise a particular Local Water Authority (LWA #8), you are the lone source of brilliance on the issue of areas of origin. LWA #8 does not own or directly handle any water. It is a governing body consisting of locally elected council members, and this council may establish regulations pertaining to water use and water rights within its jurisdiction. Suppose the State has established transferable surface water rights while granting LWAs the power to limit permanent water right exports. If they so choose, LWAs can require that x% of local water rights remain in the LWAs at the end of every year as compared to the amount at the beginning of the year.
LWAs are allowed to set x as high as 98, and they can also choose x=0 (no regulation), so $0 \leq x \leq 98$. If a "tight" rule is selected, such as x=90, then #8 will also need a procedure for selecting which trades will be approved because more trades will be proposed than can be accepted. How will you advise #8's board members on (a) the selection of x and (b) how to allocate limited trading if x=90?

10. Private trade in water rights is prohibited by law in your state. Yet the state water agency has won a judicial ruling affirming the following legal interpretations. First, water right owners can contractually surrender their rights, but only to the granting water agency, and the agency can offer financial incentives for such surrenders as long as they are formally called "water development projects" and are the cheapest available projects. Second, the agency can establish reasonable fees when it grants "new" permanent water rights. Given that 70 percent of water diversions in the state are for irrigation and

growing cities are very desirous of heightened water availability, the agency has decided to use these legal interpretations as grounds for a bank to be run by the water agency. How would you separately counsel bank administrators about setting surrender incentives and permit fees if your goal is to promote economic efficiency?