INCENTIVE PRICING HANDBOOK FOR AGRICULTURAL WATER DISTRICTS

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Section One -- Introduction

This section provides an overview of what this Pricing Handbook is about, including:

- ☞ Why Reclamation prepared this Pricing Handbook
- ☞ Why consider water rates?
- ☞ Water rates and district goals
- ☞ Challenges facing water districts
- ☞ How to use this Pricing Handbook

WHY RECLAMATION PREPARED THIS PRICING HANDBOOK

The Bureau of Reclamation prepared this Pricing Handbook to help agricultural water districts and irrigation organizations develop water rate schedules to achieve more efficient water use. The Pricing Handbook is aimed at organizations of all sizes and complexities, both federally-supplied and private.

Reasons to increase on-farm efficiency include:

- More effective use of available water supply
- Reducing drainage and erosion control impacts
- Improved crop yields and quality
- Reduced on-farm costs
- Diminished groundwater overdraft
- Improved water quality and aquatic habitat
- Improved system and water supply reliability
- Habitat maintenance for endangered species
- Removing public perceptions that agriculture "wastes" water

Products such as this manual support and strengthen Reclamation's overall water management mission. Through products such as this, Reclamation hopes to cooperatively work with others to improve water resource management and the efficiency of water use throughout the western United States. In particular, this manual supports Reclamation's responsibility, under the Reclamation Reform Act (Sections 210a and 210b) and other Reclamation law, to encourage more efficient water use by the districts it serves.

WHY CONSIDER WATER RATES?

Water rates are a powerful tool to encourage improved water management. Incentive pricing can be used to encourage efficient use in a flexible and equitable manner. Water rates should be considered in developing any water management plan.

Water rates are:

Flexible--The district can change rates to respond to changing conditions. Water rates are a powerful tool in the rapidly changing economic and institutional environment. They can be used to respond to a wide variety of goals. Water rates provide a true incentive to improve water management. Farmers then make decisions based on their own economic circumstances, thus minimizing intrusion.

Efficient--Compared to other water management measures, costs to implement water rates are low. Costs to farmers are within the farmers' discretion and hence will be in proportion to the benefits gained.

Equitable--Water rates are usually more fair than other fee systems in irrigation districts. This is an important factor in acceptance. Water rates eliminate subsidy and distribute costs according to benefits gained.

GUIDEBOOK AND HANDBOOKS

In support of water management planning activities, the U.S. Bureau of Reclamation has produced *Achieving Efficient Management, A Guidebook for Preparing Agricultural Water Conservation Plans* ("Water Management Guidebook") to assist districts in the planning process. This manual, *Incentive Pricing Handbook for Agricultural Water Districts* ("Pricing Handbook"), is a companion to the Water Management Guidebook.

The objectives of this Pricing Handbook are:

- To provide districts with tools to use in setting water rates that encourage efficient use of water
- To provide step-by-step procedures for developing and evaluating new water rates

The Water Management Guidebook provides substantial background about the motivation for water management and the water management planning process. It also helps districts assemble the information needed to formulate a water management plan. Much of that background and information is useful to the development of conservation-oriented water rates. To avoid duplication of effort, we refer to the Water Management Guidebook wherever possible.

WATER RATES AND DISTRICT GOALS

The process of planning is one of setting goals and defining means to meet the goals. The goal setting process is critical to success. Water rates can be used to reach many goals of a district, such as water conservation, increased equity, flexibility and so on. But, water rates are exceptionally effective in addressing *revenue* goals in combination with other goals. In general, the district's revenue goals will be assumed to fall into one of the following categories:

1. Maintain Revenues at Current Levels
2. Increase Revenues
3. Minimize Volatility of Revenues

CHALLENGES FACING WATER DISTRICTS

Irrigated agriculture and the water districts that deliver agricultural water supplies have always faced competition from other agricultural interests. However, districts are now confronted with exceptional challenges and opportunities. Farmers exist today in an economic and financial environment where the line between success and failure is narrow. What determines the difference between a profitable farm and an unprofitable one is now, more than ever, the management skill of the farmer. Like farmers, water districts exist in an exceptionally challenging environment. Management challenges facing water districts come from three principal areas:

Decreasing Federal Support

- Responsibilities are being shifted to the districts
- Districts have additional financial, operational and management burdens
- Districts need additional staff and funds for maintenance and operation
- Districts must establish and fund sinking funds for replacement of facilities

Increasing Political, Legal and Social Oversight

- Environmental assets are increasingly viewed as "common" property or as a public trust
- Public understanding of agriculture is at a low point
- Society has higher standards for the protection of both the quantity and quality of the nation's water resource

- Pressure to operate water supply systems to a higher standard of efficiency is increasing

Increasing Competition for Water

- Water used by farmers is valued by society for environmental and recreational purposes
- Municipalities need additional sources of water to support growing populations
- Pressure for a resource largely controlled by farmers or water districts is increasing

HOW TO USE THIS PRICING HANDBOOK

This Pricing Handbook has been designed for water districts that wish to explore whether adopting water rates will promote more efficient water use by water users. It has been written for readers who understand agriculture but not necessarily the economics of agricultural water use. We have designed forms and worksheets to facilitate rate design, with examples at each important step. Example farmers and example irrigation districts have been invented to illustrate concepts and procedures. These example districts and farmers are carried through all the analyses in the Pricing Handbook.

This Pricing Handbook may be a valuable resource for district managers, farmers, lenders and anyone interested in agricultural water pricing. For district managers, the Pricing Handbook will provide a step-by-step process for collecting information and determining the most appropriate rate schedule for your district, and for calculating the new water rates and evaluating their impacts. For farmers, the Pricing Handbook provides the economic rationale behind water rates. It also gives some guidance about how to respond to water rate changes to minimize costs of production. For lenders, the Pricing Handbook will give insights into financial impacts and help evaluate if water rates are financially sound.

Section Two -- Water Rates as a Management Tool

This section of the Pricing Handbook will introduce you to the relationship between water demand and water rates. It will:

- ☞ Explain how water demand can be managed with water rates
- ☞ Explain the criteria for a good rate schedule
- ☞ Outline some of the issues and problems your district might encounter as you implement water rates

PRICE VS. NON-PRICE CONSERVATION PROGRAMS

This Pricing Handbook focuses on the incentive pricing component of water demand management. The price of water affects farmer decisions regarding water use and therefore can be a key component of demand management. There is a fundamental difference, however, between price and non-price conservation measures.

The primary aim of non-price conservation programs is to directly reduce inefficient water use. Water rates, on the other hand, really serve to provide incentives for more efficient use of water. In practice, when water rates are first put into place, water use usually decreases as inefficient practices are modified.

A further difference from non-price water conservation measures is that water rates have multiple purposes. In addition to potentially being used as a demand management tool, water rates are also the means by which a district generates revenues to cover costs. Revenue goals and water conservation goals can be consistent but they can also conflict. This tension is compounded by the fact that farmer acceptance of incentive pricing depends on the perception of fairness and how profit will be affected. These issues will be of fundamental importance as we help guide you through the process of developing an incentive pricing program.

DEMAND MANAGEMENT

Water demand management refers to the integrated use of conservation practices and pricing to influence water use -- both the total level of water use *and* the pattern of use. Demand management focuses on the end user. The primary goal for irrigation districts embracing water demand management is to get farmers to increase their water use efficiencies to assure supplies for other purposes or future needs. Successful management of

water use replaces the need for additional water supplies and can forestall certain supply costs. However, water demand management programs also come with their own costs. Therefore, the appropriate use of water demand management is not to replace supply-side sources and investments but rather to encourage a cost-effective mix of supply and conservation resources.

What is Incentive Pricing?

Incentive pricing involves setting water rates that provide motivation to use water efficiently. Pricing can consist of a fixed charge (a constant fee assessed to landholdings or acres in production), a water rate (a price per-acre-foot of water delivered), or some mixture of the two. The combination of fixed charges and water rates is the district's rate schedule.

Incentive pricing moves away from rate schedules based solely on per-acre fixed charges and toward rate schedules that incorporate both fixed charges and per-acre-foot water rates. Thus, conservation-oriented rate schedules allow individual farmers to be accountable for their own water applications. For example, under a per-acre-foot water rate the costs of an individual farmer's inefficient water applications are no longer shared by other landholders within a district; rather, the farmer is solely responsible for paying for his or her water deliveries.

Benefits

Under incentive pricing, there is a direct relationship between farm deliveries and water bills so the incentive to take unnecessary deliveries is reduced and water will be used more efficiently. Efficient use of water is the foundation of good water management. Please refer to the Water Management Guidebook for additional discussions of the benefits of water management in general.

Incentive pricing has several advantages compared to non-price conservation measures:

- **Cost**: The costs of implementing a new rate schedule are relatively low compared to altering an irrigation system, provided the district has an adequate measurement system in place.

- **Flexibility**: The district can respond to changing conditions quickly and easily by adjusting its rate schedule.

- **Revenues**: Conservation can bring about a reduction in water use while maintaining or enhancing district revenues.

- **Accountability**: Incentive pricing lets farmers make their own decisions. When the farmer's bills track the costs directly attributable to his or her actions, the farmer receives better signals regarding the district-wide consequences of those actions.

- **Equity**: Water users are charged only for *their own* use. If a district has all fixed charges a farmer who uses water excessively pays the same as a farmer who uses water efficiently. With per-acre-foot water rates, farmers are responsible for paying for their own water applications.

Potential Problems

There are four factors which complicate the incentive pricing process:

1. Gathering the technical details to support the design and administration of workable rate schedules

2. Addressing conflicting opinions regarding fairness, efficiency and what the district goals should be

3. Anticipating the interaction between farmers' water use and the chosen rate schedule

4. Supporting the farmers' efforts to increase efficiency

The time required to design, communicate, implement and maintain the revised rate schedule can be much greater than originally anticipated. A district will ultimately need operational, measurement and accounting systems for implementation of incentive pricing, though interim measures are available and are discussed later in this Pricing Handbook. It will also need a billing system that can convey to the farmer in a regular and timely manner the per-acre fixed charge, the number of acre-feet delivered and the per-acre-foot cost of water.

If historical farm deliveries are maintained, some farmers' water bills will increase under incentive pricing. Therefore, revisions to a district's rate schedule will undoubtedly be met with some level of farmer resistance. To reduce farmer opposition a district must ensure that the revised rate schedule is understandable by all district members, is a relatively small departure from the historical rate schedule, and is equitable.

In most districts water rates have not been used, so there will be no experience, on the part of the district or its irrigators, that can be used to estimate what will happen to water use when rates are introduced or changed.

Once a district has implemented incentive pricing, farmers will likely require more flexibility and control of delivery rates and schedules. These requirements may strain existing district facilities and operations.

REVENUE CONSIDERATIONS

As mentioned before, in addition to potentially being used as a demand management tool, water rates are also a means by which a district can generate revenues to cover costs. Because incentive pricing implies a movement toward schedules that incorporate per-acre-foot water rates, a district's revenues become more sensitive to water use. This can be a major concern for districts that are strapped with large fixed costs and debt obligations that are independent of water use levels.

Revenues from charges on water use are referred to as water rate revenues. Water rate revenues are equal to the total volume of water used multiplied by the water rate. If a district increases its water rate there will likely be some adjustment downwards in total volume of water used. This is the basic idea behind incentive pricing. If water use decreases less than the water rate increases (each measured on a percentage basis) then water rate revenues will increase. Given a normal flow year, once crops have been planted and the production season is underway, irrigators are not expected to make drastic changes in water use as a result of a change in water rates (a topic we discuss in more detail in the next section). While it is reasonable to expect that water rate revenues will increase, it will be difficult to predict exactly how much they will increase.

The problem of uncertain water rate revenues is exacerbated during low flow years. Because it is difficult to predict supplies from one year to the next, the district is confronted with another source of uncertainty when it moves toward a greater dependence on water rate revenues. In general, the unreliable nature of water rate revenues will necessitate a gradual reduction in fixed charges, rather than elimination of fixed charges, as a district implements incentive pricing. This issue will be addressed in more detail in Section Seven.

WHAT IS A GOOD RATE SCHEDULE?

Some essential criteria of a good rate schedule are:

- It encourages efficiency
- It provides stable revenues
- It is understandable
- It is fair

Efficiency

The rate schedule should encourage efficient use of irrigation services. When a district elects to use water rates to encourage efficient water use, the rate schedule selected should be effective at reducing water use by less efficient irrigators. Some rate schedules will be more effective than others in encouraging efficient use of water.

Revenue Stability

The rate schedule should generate revenues that, along with other revenues, will cover all district costs. The revenues should be stable and somewhat predictable. A primary concern for any district is its ability to generate revenues sufficient to cover O&M costs and contract obligations. Prior to designing a new rate schedule, a necessary step is to determine if the schedule should be revenue-enhancing or revenue-neutral. Revenue enhancement ensures that revenues exceed the amount necessary to cover total district costs.

Districts may consider revenue enhancement if:

- District facilities are depreciating so that maintenance costs are increasing
- Revenue reconciliation is not achievable during low flow years
- A surplus account from which to offer low-interest loans to irrigators is desired

Revenue enhancement offers the advantage of creating a buffer to guard against unpredictable circumstances. In essence, revenue enhancement can be viewed as a district's "safety net." Because districts require a certain amount of annual revenue to cover operational costs, the most conservative rate schedule should generate this minimum revenue each year regardless of farm deliveries. Collection of minimum revenue can be guaranteed with fixed charges. However, a district may successfully use a rate schedule that does not fully meet

minimum revenues in low-delivery years if surplus revenues in high-delivery years are sufficient to fill the shortfall and are retained as cash reserves.

Farmers need to be able to anticipate their water bills in order to make sound production decisions regarding the upcoming season's crop and water use. This is another side of revenue stability viewed from the farmer's perspective. Farmers need a certain amount of predictability for planning purposes. In general, incentive pricing increases the instability of water bills just as it does district revenues. Like water districts, farmers can manage fluctuating bills, but a conservative approach minimizes the variation in bills from year-to-year.

Simplicity and Understandability

Clear, direct relationships between water rates and water bills are crucial. To meet this objective, management must limit the number of alterations to current water management policies. Restricting changes will permit a level of familiarity to remain under the new rate schedule. For some district members, familiarity with the new rate schedule will reduce their hesitation to accept it.

Farmers' water bills should be designed so that farmers can relate a particular bill to a particular action on their part. The revised schedule should demonstrate a clear relationship between farmers' water deliveries and farmers' water bills.

Fairness

Farmers who are making a conscious effort to be efficient should not have to pay for deliveries to farmers not making an effort. Instead, the rate schedule should be constructed such that efficient water users are encouraged to maintain their practices.

ISSUES IN CHANGING RATES

Changing rates is not easy. It is important to have a realistic view of the process at the outset and be prepared for the challenges you will face as you guide your district toward incentive pricing.

Designing Rates

The process of setting water rates, as outlined in this Pricing Handbook, is a substantial undertaking in itself. Gathering the technical information and putting it together to calculate a new rate schedule involves considerable effort and thought. The effort required to start using incentive pricing is rewarded by increased flexibility and efficiency and possible opportunities to benefit from alternative uses of conserved water.

Estimating Farmer Response

The most significant technical problem in setting new rates is estimating the farmer's response to incentive pricing. Farmers' responses to water rates are very specific to their particular circumstances, their history, the types of crops they produce, their soils, and their costs of production. Because these factors are known for very few districts in the West, you must move carefully when you set rates. Fortunately, in most cases, it will be hard to err in the direction of reducing district revenues. Nevertheless, we propose a gradual and very conservative approach to putting new pricing in place. This gradual approach will help you adapt to farmer responses.

Staffing and Training

In some cases existing personnel will require additional training. In other cases incentive pricing may require that new personnel be hired to administer water ordering,

measurement, delivery or billing. The benefit of this investment in additional capability is a more agile district, better able to cope with the changes inherent in today's business and environmental climate.

Facilities and Operations

You should anticipate that the farmers in your district will demand service improvements to help them increase efficiency. Farmers may require better scheduling systems and the facilities to support them.

Measurement and Accounting Systems

Every district that uses incentive pricing must have some kind of water measurement and accounting system. New procedures must be developed to accommodate new ways of ordering water, delivering water, accounting for water and billing water users. In the absence of a metering system, water deliveries may be estimated, so long as the method of estimation is consistent and is acceptable to both the irrigator and the district.

Acceptance

The most difficult part of using incentive pricing is that it requires a change from long-established practices. In many cases today's rate schedules and billing practices have been in use for as long as the district has existed. Trying to bring change to an organization with a long history of successful operations will be difficult. However, incentive pricing offers real advantages to water users in the district, advantages that will help facilitate its acceptance. Foremost among these is equity--each water user will be responsible for his or her own water use and its costs.

Acceptance can be encouraged by using increased revenues to improve district facilities and to increase district financial stability, improving the situation for all district water users. In addition, revenues from new water rates can be returned to water users as rebates, loans, or grants.

Section Three -- Water Rates and Rate Schedules -- Under the Hood

This section of the Pricing Handbook will give you some background information about incentive pricing. It will:

- ☞ Describe how water rates can be used to manage water use and revenues
- ☞ Explain how water rates encourage efficient use
- ☞ Show how different rate schedules can be used to address different district goals

INTRODUCTION TO RATE SCHEDULES

Incentive pricing is the process of assembling a **rate schedule** that targets the goals of a district and generates the revenues desired by the district. A rate schedule is the description of specific **rate components** put together into a package. Rate components may be fixed charges or water rates. Typically, there are a variety of different rate schedules which may achieve the same level of total revenue but differ across other criteria.

Example: Fixed-Charge-Only Rate Schedule

The fixed-charge-only rate schedule is the simplest. The district does not have a per-acre-foot water rate, rather it has a per-acre fixed charge, usually assessed at the beginning of the year. All land owners are required to pay the charge regardless if they use water that year or not. Districts usually base their charges on their total annual costs and the amount of acreage within the district. The following formula is frequently used:

FIXED CHARGE = REQUIRED DISTRICT REVENUE/TOTAL DISTRICT ACREAGE

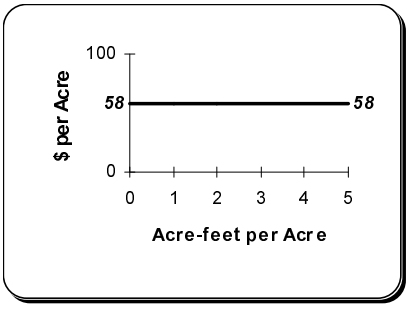


Figure 3.1: Fixed-Charge-Only Rate Schedule

Let's look at an example district. District A has annual O&M costs and contract obligations totaling $1,740,000. With district acreage of 30,000 and total deliveries of 120,000 acre-feet, the annual fixed charge is $58 per acre. From the farmer's perspective, the average price per acre-foot of water decreases as deliveries increase, because the per-acre fixed charge is spread over more units of water. This rate schedule is illustrated in Figure 3.1.

The drawback of this rate schedule is its lack of incentive to efficiently manage water. Because a reduction in deliveries does not reduce the total water bill received by

farmers, they see no direct benefit of lowering their total farm deliveries. The farmer in District A sees a bill of $58 per acre no matter how much water he or she uses.

Example: Water-Rate-Only Schedule

Under a water-rate-only schedule, farmers pay a specified water rate per acre-foot of delivered water. Each additional acre-foot of water is subject to a water rate. Districts base their water rate on total annual cost and total annual water deliveries according to the following formula:

WATER RATE = REQUIRED DISTRICT REVENUE/TOTAL ANNUAL WATER DELIVERIES

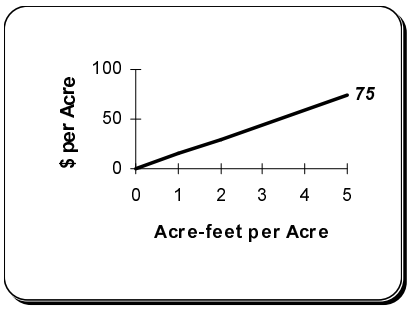


Figure 3.2: Water-Rate-Only Rate Schedule

Unlike District A, a water-rate-only district has a water rate rather than a fixed charge. The farmer's water bill goes up directly with the amount of water delivered. This rate schedule is illustrated in Figure 3.2 on a dollars-per-acre basis, where the water rate is $15 per acre-foot.

While this rate schedule promotes efficient use of water, it doesn't generate a *stable* revenue stream. Total district revenues are directly related to total district-wide water deliveries. If water supplies fluctuate from season to season, resulting in variable water deliveries by the district, then revenues may occasionally fall short of that necessary to cover essential O&M costs. A solution to this problem is to design a rate schedule that includes both fixed charges and water rates, thus providing a reliable source of revenues each year. This type of combination rate schedule is illustrated in the next example.

Example: Combination Rate Schedule

Under a combination rate schedule, a portion of district revenues are generated from fixed charges and a portion are generated from water rates. Districts have the

opportunity of determining what percentage of revenue is derived from each source. If water supplies fluctuate from year to year, a district may choose to have a larger portion of its required revenue come from fixed charges because they are independent of water supplies. Also, the combination of fixed charges and water rates can discourage inefficient water use without penalizing efficient use.

District B has the same acreage, contract obligations and average water deliveries (4 acre-feet per acre) as District A. Let's say District B will have its revenues come from both fixed charges and water rates. Districts base their fixed charges and water rates on their total annual cost and total annual water deliveries according to the following formula:

FIXED CHARGE = % FROM FIXED CHARGE X (REQUIRED DISTRICT REVENUE/DISTRICT ACREAGE)
WATER RATE = % FROM WATER RATE X (REQUIRED DISTRICT REVENUE/ANNUAL WATER DELIVERIES)

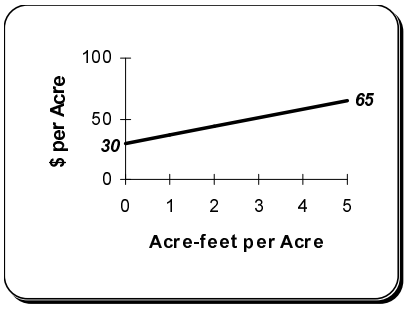


Figure 3.3: Combination Rate Schedule

District B chooses to apportion its two revenue sources as follows: 52 percent from fixed charges and 48 percent from water rates. Using the formulas above, these proportions result in a $30 per-acre fixed charge and a $7 per acre-foot water rate. The farmer in District B is billed according to usage, but the effect of using more water is not as direct as in the water-rate-only district. The rate schedule for District B is shown in Figure 3.3, where the total per-acre charge is used.

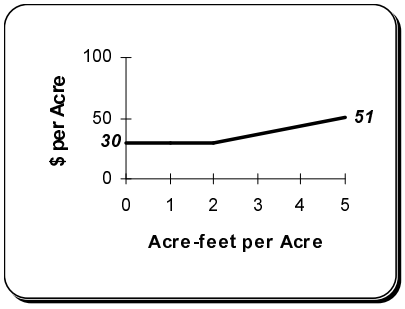


Figure 3.4: Free Water Block Rate Schedule

Another option is to implement a fixed charge with a free water block as well as a water rate. Suppose a district decides to allocate farmers 2 acre-feet for the payment of their fixed charge. In essence, the use charge for these first 2 acre-feet of water is $0 per acre-foot. In a district like District B, with a free water block, the schedule would generate $900,000 in fixed charge revenue ($30 x 30,000 acres) and $420,000 in water rate revenue ($7 x 60,000 acre-feet). These two amounts underachieve desired revenues by $420,000. The free water block rate schedule is illustrated in Figure 3.4.

Because total revenue necessary to cover operation and maintenance costs has not changed, the district must generate the lost revenue attributable to the 60,000 acre-feet (2 acre-feet x 30,000 acres) of "free water." One option would be for the district to increase its per-acre fixed charge. Another option would be to implement a tiered rate schedule.

Example: Tiered Rate Schedule

In tiered rate schedules farmers also receive a specified allotment of water for the payment of their fixed charges, however, the district creates a second block (higher) water rate to recapture the revenues lost by this policy.

Suppose that in addition to the $30 per-acre fixed charge, the district offers its members 2 acre-feet per acre at a first block water rate of $2 per acre-foot. Under this scenario, the district would generate $900,000 in fixed charge revenue and $120,000 in water rate revenue, from the first block, assuming all acreage within the district received at least 2 acre-feet. Because this rate schedule underachieves required revenues by $720,000, the district must construct a second block water rate that generates this amount. With 60,000 acre-feet of total district deliveries already accounted for, the remaining deliveries must be divided into the additional required revenue. This yields a second block water rate of at least $12 per acre-foot ($720,000/60,000 acre-feet). This tiered rate schedule is presented in Figure 3.5.

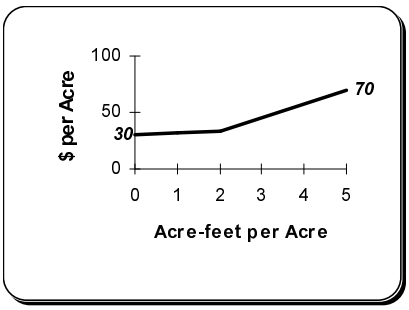


Figure 3.5: Tiered Rate Schedule

COMPARING RATE SCHEDULES

To help you compare the value of different rate schedules for your district, the advantages and disadvantages of the five example rate schedules are summarized in Table 3.1. The checks indicate degrees of conformance with each category.

Table 3.1: Pros and Cons of Different Rate Schedules

Rate Schedule Type	Understandable	Flexible	Revenue Stable	Encourages Efficiency	Equitable	Requires Measurement and Scheduling System
Fixed Charge Only	✓✓✓	✓	✓✓✓			
Water Rate Only	✓✓	✓✓	✓	✓✓✓	✓✓✓	✓
Combination	✓	✓✓	✓✓	✓✓	✓✓	✓
Combination with Free Water Block	✓	✓✓	✓✓	✓✓	✓✓	✓
Tiered	✓	✓✓✓	✓✓	✓✓✓	✓✓	✓

HOW RATES AFFECT WATER DEMAND

In arid regions, irrigation water is necessary to bring a crop to harvest or to increase yields above that possible from natural precipitation alone. Water is one of many such ingredients or *inputs* to the process of growing crops. Water isn't any different from land, fertilizer, labor and other inputs that are absolutely necessary for production. Like the farmer's demand for any other input, the demand for water reflects how valuable water is in production.

Irrigation water derives its value from the contribution it makes to farm profits. Farmers apply irrigation water to increase yields and earn higher profits.

But, there is a limit to the benefits a farmer will gain by applying additional water. At some point, applying additional water will cause yields to decrease. Before this point is reached, though, other factors may reduce the benefits from applying additional water. For example, fertilizer or labor costs may increase, or the soil may be too moist to support cultivating equipment.

When additional water is available at no cost the farmer will apply more water until there is no additional benefit

to be gained from doing so. At this point the farmer will be maximizing profit on his or her farm. However, this profit-maximizing behavior may harm others by, for example, taking water from a ditch that would otherwise be used by a water-short farmer or by inflicting drainage problems on another property. Thus, while from the farmer's point of view his or her water use may not be excessive, the district or other farmers may take the opposite view. Water use by a farmer may be excessive if it causes water shortages, water allocation problems, drainage problems or inequity.

When additional water is not free the farmer must compare the amount of additional profit resulting from applying additional water with the cost of the water. For example, if applying an additional acre-foot of water to grass hay would cause additional yield worth $15, then we would say that the value of that acre-foot of water in agricultural production is $15.

If water costs the farmer $10 per acre-foot, he will obtain an additional profit of $5 for the additional acre-foot of water. On the other hand, if the next acre-foot of water increased yields by only $8, then the value of water is less than its price ($8 vs. $10) and the farmer will lose money by applying the additional acre-foot.

If we want the water user in this last example to cut back water use to eliminate the last acre-foot of irrigation, we should charge a water rate of at least $8 per acre-foot, because, at that price, there is no additional profit to be gained by applying the additional acre-foot. This is the basic principle of incentive pricing: set a water rate that discourages inefficient use of water.

CONCEPT OF ELASTICITY

In the example above, we showed that one way farmers can react to an increase in water rate is by eliminating unprofitable water use.

Elasticity *is the ratio of the percentage change in water use for a given percentage change in price*

In setting district water rates we want to know how much we can expect water use to decrease after a water rate is put into place. To calculate how much water use will change we use the concept of ***elasticity.***

Elasticity is a measure of how much water use will change for a given water rate change (Figure 3.6). The changes in water use and price are measured in percent. If an increase in price of 10% would cause a decrease in water use of 10% then the elasticity is said to be 1.0.[1] Similarly, if an increase in price of 10% would cause a decrease in water use of just 5% then the elasticity is said to be 0.5. Later in this Handbook we will recommend that you start with an elasticity of 0.2 when estimating water use for your district. This means that if you increase water prices by 10% you expect water use to decrease by 2%.

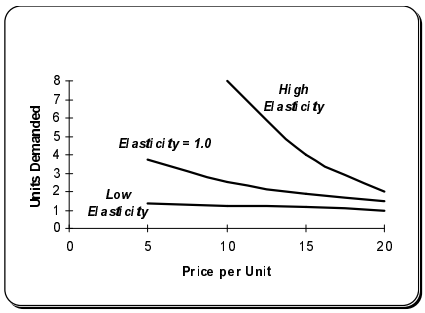


Figure 3.6: Elasticity

ELASTICITY = PERCENT CHANGE IN WATER USE/PERCENT CHANGE IN PRICE

THE RESPONSE PRICE

We have seen that farmers respond to changes in price by changing their decisions so that they maximize their profit from water. But, to what price does the farmer respond? Economic theory suggests that farmers respond to changes in the water rate but not to changes in the fixed charge. Take for example a farmer who is in a district that has only a fixed charge and no water rate. Once he has paid the fixed charge, the farmer can use as much water as he wishes. If the fixed charge was increased you would not expect the farmer to reduce water use. In fact, the farmer might increase water use in an attempt to "get his money's worth." Thus, we would say that the elasticity of water use to changes in fixed charges is very low.

[1] In Textbooks **Elasticity** is often given a minus sign to reflect that as price goes up, demand goes down. For simplicity, we are omitting the minus sign in this Handbook. Also, elasticity is more technically referred to as "price elasticity of demand" in textbooks. Again, we have simplified the term for the Handbook.

When there is a fixed charge and a water rate, economic theory says that increasing the fixed charge won't cause the farmer to reduce water use but increasing the water rate will. In practice, it's not so simple. If the farmer's total water bill makes up a small part of the farmer's total cost, then changes to either fixed charges or water rates will not elicit much response. On the other hand, if the total water bill is a significant part of the farmer's overall cost, then changes in either fixed charges or water rates (either of which cause the total water bill to increase) may cause the farmer to change water use.

Why would a farmer reduce water use in response to an increased fixed charge? If the total water bill is a large part of overall costs, then the increased water bill will cause a significant reduction in farm profits. The farmer may attempt to restore some or all of the lost profits by reducing costs. The farmer might reduce fertilizer use, increase mechanization to reduce labor costs, or, when there is a water rate, reduce water use to reduce water costs. Water is as much a candidate for cost saving as any other farm input. The farmer's decision as to which input to cut back will be made on the basis of which will recover the most cost with the least impact on revenues. One cannot say for certain that increases in fixed charges will lead to reductions in water use, however, contrary to conventional wisdom, when a farmer is paying both a water rate and a fixed charge, increases in fixed charges may indeed lead to reductions in water use.

The farmer's sensitivity to changes in fixed charges increases as the total water bill makes up a larger proportion of total costs and as the overall profitability of the farming operation decreases.

*The **Response Price** is the average of the district-wide average price and the water rate*

When we estimate the effect of rate changes in this Handbook, we use a concept called the **response price**, which combines the effect of both the fixed charge and the water rate.

The formula for the response price is:

RESPONSE PRICE = (DISTRICT AVERAGE PRICE + WATER RATE) / 2

*The **District Average Price** is the total district revenue divided by the total acre-feet of water delivered*

In this Handbook we want to examine farmer response to water rate changes on a district-wide basis. We don't want to examine each farmer's bill separately, instead we want to understand how all the farms in the district as a group will respond. For this reason, we use the ***district average price*** to help us calculate the response price. The district average price includes revenues from both fixed charges and water rates. When water rates are low or non-existent, the district average price tracks the farmers' fixed charges closely.

We use the response price for a variety of reasons. As we have said above, it incorporates the farmer's response to fixed charge changes. It also can be easily calculated on a district-wide basis and it can be calculated even when a district has no water rate.

Because the response price is calculated as the average of the district average price and the water rate, it treats both of those prices as being equally important in farmer decisions. We have shown that farmers as a group respond to both average price (total water bill) and water rate, but we can't predict for your district how much weight your water users, as a group, will give to the two factors. What matters most is using a consistent measure of price as you adjust your water rates. The response price provides you with just such a measure.

USING ELASTICITY TO ESTIMATE REVENUE AND WATER USE

We can use elasticity to estimate the effect of a new rate schedule on water use and revenues. In this section we will show you the principles for using elasticity. Later we will give you step-by-step instructions to make these calculations for your district.

Remember that elasticity tells us how much water demand is going to change for a given change in price. We can restate our formula for elasticity this way:

PERCENT CHANGE IN WATER USE = PERCENT CHANGE IN PRICE X ELASTICITY

Our first step is to calculate the response price for the district *before* new rates are put into place. Recall that the response price is the average of the district average price and the water rate. Next, we must calculate the new response price *after* new rates are put in place.

Once we have the "old" and "new" response prices we can calculate the percentage change in price. Then, we can calculate the expected change in water use, in percent, by multiplying the percent change in response price by the elasticity.

For example, if your district has an elasticity of 0.2 and you are going to increase the response price by 10%, then you would expect water use to decrease by 10% x 0.2, or 2%.

FACTORS INFLUENCING ELASTICITY

For agricultural water use, the short-run elasticity is much lower than the long-run elasticity. This is because the farmer has less flexibility to adjust water use over the course of one season than over several seasons. In the long-run, the farmer can change the type of irrigation system or crop grown. During a single season or less, the farmer can only respond by cutting back on irrigations if the crop tolerates less water, or by maintenance of the irrigation system to keep efficiencies up. If the system is already well-maintained and the crop is sensitive to dry conditions, there is not much that a farmer can do to respond to higher water rates. The important point for the district to understand is that incentive pricing will have its greatest impact on water use over the course of several years.

There are several other factors that affect elasticity:

Other Water Sources: If the farmer can switch to another water source, such as ground water wells, the relative cost of the alternative water source will affect the elasticity. The elasticity for farmers with alternative sources of water will be higher.

Crop Value: If farmers are growing low-valued crops such as pasture and hay, an increase in water rates may significantly decrease profitability to the point that the

farmers will cut back on the amount of irrigation applied to the crop. Elasticity is higher with low-valued crops than with high-valued crops.

High Production Costs: With high production costs, water costs are a small percentage of total costs. Even though water rates increase, there may be only a small increase in total cost of growing the crop. There would be little incentive to alter irrigation methods. Thus high production costs lead to low elasticity.

Soil Types: Soils vary in their water holding capacity. Sandy soils require more frequent irrigations because of reduced capacity. Irrigation timing is more troublesome and it is more difficult to change practices. Therefore, the elasticity for the farmer irrigating on sandy soils is lower.

Application Rates: If farmers are applying high or excessive amounts of irrigation water relative to the consumptive use requirements of the crop, there is room for conservation. Thus, elasticity for farmers using excessive amounts of irrigation water will be higher.

Ability to Change Crops: Climate, soils and markets allow the farmer to diversify crops. The ability to choose crops that use relatively little water will increase elasticity.

Ability to Change Irrigation Technology: Farmers may respond to increased water rates by switching to more efficient but more expensive irrigation technologies. The greater the ability to switch to water-saving irrigation technologies, the higher the elasticity.

These factors represent constraints on the farmer's flexibility to change irrigation practices. The less flexibility the farmer has, the lower the elasticity. The elasticity for agricultural water use is generally very low. It is difficult for farmers to immediately adjust their water use in response to increased water rates. Districts can expect small percentage decreases in water use over the first few years. Also, water rates in irrigation districts throughout the West are currently very low; therefore, a small increase in an already low water rate results in a large percentage change in the rate. A small percentage change in water use divided by a large percentage change in water rate equals a very small elasticity value.

Section Four -- Guiding Your District

This section of the Pricing Handbook will help you communicate your district's goals and the rate-setting process to irrigators and others. It will:

- ☞ Provide a map of the pricing process
- ☞ Provide communication methods and ideas
- ☞ Help you develop a customer-involvement plan

INCENTIVE-PRICING PROCESS

The incentive-pricing process is laid out in Figure 4.1.

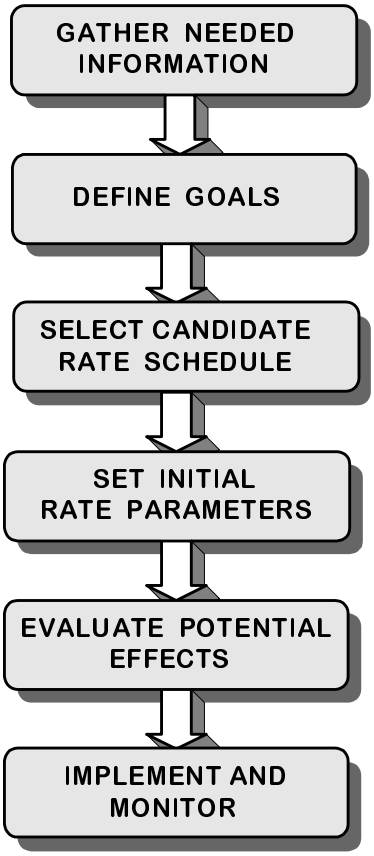


Figure 4.1: The Incentive-Pricing Process

The first step in the process is to gather information about water use, fixed and variable costs and revenue sources for your district. The second step is to define your district goals with respect to water conservation and revenue. The third step involves selecting a rate schedule type that is a modest change from your current rate schedule type. In the fourth you will set the initial rate parameters of fixed charge and water rate. The fifth step is to evaluate the water savings and revenue effects of the new rate schedule. The last step is implementation and monitoring the rate schedule over time.

Each of the steps in the incentive pricing process is described in detail in the following sections.

Before beginning the incentive-pricing process, and throughout the process, you must take pains to communicate effectively with district management and irrigators. Careful attention to communication will pay dividends by making the process of setting up incentive pricing easier and, by obtaining cooperation from all parties, making the rates themselves more effective.

In the sections immediately following this one we discuss the importance of communication and give you some guidelines on how to do it.

IMPORTANCE OF COMMUNICATING WITH STAKEHOLDERS

Communication with stakeholders in the planning and implementation of incentive pricing is critical to the success of a program. District managers know that it would be foolhardy, if not specifically prohibited by district bylaws, to design a new set of policies and attempt to implement them without warning. The affected parties must both understand and support the policies for incentive pricing to be credible and effective.

Communication between the district board, irrigators and affected parties is the key link in developing the necessary understanding and support of the goals and policies established to achieve those goals. It is particularly important to communicate how the selected rate schedule is anticipated to achieve the district's goals and the expected impacts on water users and interested parties.

There are advantages to recruiting your customers to participate in the rate-setting process. Involving the farmers in the process will help you achieve three objectives:

- Establish credibility
- Identify farmers' concerns and values
- Develop a consensus between the district and its customers

Acceptance of rate changes will be improved if water users clearly understand the district's reasons for the proposed changes. In developing and discussing conservation programs and rates, it is all too easy to forget that water conservation is not the objective in itself, but instead is used to achieve other specific objectives or goals of the district and water users.

Some of the goals that drive the need for water conservation are products of changes in the political and

social environment in which districts now operate. Thus, it is very important for district management to identify the district's goals and effectively communicate these goals to water users and other interested parties. This communication is even more important when there is a divergence between a district's goals and the goals of some individual water users.

The people who are most obviously affected by rate changes are district irrigators. Water management programs are designed to influence water use. Conservation-oriented changes in rates are particularly controversial because they have the potential to directly affect users financially, in addition to modifying the water consumption.

METHODS OF COMMUNICATION

A variety of methods can be used in communicating the implementation of new rate policies. Reclamation has published a *Public Involvement Manual (1980)* that has useful information for involving stakeholders in decision-making processes. It has identified several steps for developing a public involvement plan:

Step 1. Identify the decision-making process

Step 2. Identify the customer involvement objectives for each stage in the process

Step 3. Identify the information exchange which must take place at each stage

Step 4. Identify the individuals or groups who should participate

Step 1 is what Sections 5 through 7 of this Pricing Handbook are about. Those sections will lay out for you the key steps in the rate-setting process. In Step 2, the district must decide what it wants to achieve by involving its customers in decision-making. Once the objectives of involving the farmers is determined, the particulars of what inputs you need from the farmers and

what information they need from you must be identified (Step 3). In Step 4, the individuals and groups who will be involved, and the stages at which they will be involved, are determined.

The following table (Table 4.1) is a very simple example of a customer-involvement plan for setting new water rates.

Table 4.1: Sample Customer Involvement Plan

Schedule	Activity	Participants	Objective	Techniques
As soon as district has committed to investigating rate-setting	Notification of intention to investigate new water rates, brief explanation of goals and rationale, announcement of meeting	District staff and district irrigators	To inform potentially affected parties	Mailer, bill insert, newsletter, press release
Soon after notification	Initial presentation and discussion	District staff and district irrigators	To lay out process, let irrigators express opinions, solicit suggestions, views, elect/select advisory committee of irrigators willing to commit time to understand the technical details	Town meeting format
Periodically, as technical details of rates are worked out	Advisory committee meetings	District staff, advisory committee, and interested irrigators	Develop rate schedule options, evaluate alternatives, set implementation schedule	Workshops with specific product as the goal of each meeting
Before implementation	Final presentation	District staff and district irrigators	Explain rate schedule, impacts on revenues, water use, farmers' bills, schedule of implementation, elect/select ombudsman	Town meeting format
Before implementation	Farm-level workshop	District staff or advisory committee and small groups of irrigators	Explain implementation, effects on this group of farmers	Workshop in private home
Annually	Follow-up	District staff and district irrigators	Present results, problems, modifications to initial rate schedule, solicit views	Include in district annual meetings

RATE CHANGE IMPACTS ON THE DISTRICT AND WATER USERS

Probable district-level impacts can be estimated using the district-level worksheets from Section Five in this Pricing Handbook. District managers may wish to communicate with a sample of representative water users to establish farm-level estimates and verify the accuracy of the assumptions regarding water user conditions and response (use the *Bill Impact Worksheets,* Tables 6.8 through 6.10). It is important to communicate the assumptions that were used in developing the impact estimates to improve user understanding and acceptance of the program. As part of the overall evaluation, and in preparation for discussion with district users, district managers should evaluate and be prepared to address a range of water user, hydrologic and market conditions, such as lower or higher user responses, varying water supply conditions and changes in crop mix, that affect estimates.

Farmers should also be encouraged to use the expertise and assistance of other resources such as the Cooperative Extension Service and Natural Resource Conservation Service to discuss ways to change water use and increase farm productivity.

WORKING WITH LENDERS

Decreasing federal support for agricultural water resources means that districts have additional financial burdens that must be met by other sources. Districts are increasingly likely to find themselves turning toward lenders for project financing. Lenders will be interested in the adequacy and stability of the district's revenue. The primary concern of rate changes will be in regard to impacts that may reduce the district's ability to pay. Since the district's ability to pay is linked directly to the water user's willingness and ability to pay, district managers will need to document and communicate the analysis of water user impacts.

District managers need to work directly with water district lenders to provide information and assurance that the new rate schedule will satisfy lender conditions and district repayment obligations. Using this Pricing Handbook, the district can estimate water user response and the impacts on district revenue and costs. In general, farm water demand is relatively inelastic, at least in the short-run. Therefore, with reasonable increases in water rates, district revenues are more likely to increase, increasing the district's ability to pay. The district and lenders will want to monitor long-term changes in farm operations that may affect district revenue.

WORKING WITH REGULATORS

In some cases, changes in rates and related water reallocation may be governed by local, state or federal regulations or contracts. Since these issues and regulations vary from district to district and state to state, the Pricing Handbook provides only general guidance for identifying potential rate-related regulatory or contractual issues and communicating with the appropriate organizations.

Changes in water rates may result in an increase or decrease of revenues over current costs. Irrigation districts that are classified as non-profit organizations may be restricted in their authorization to collect revenues that are above current costs. The use of capital improvement or depreciation accounts may help resolve this situation. District managers should investigate and be aware of any capital accumulation restrictions prior to the implementation of a new rate schedule.

Contractual obligations may exist that specifically prohibit anything other than fixed fee or tiered rates. District managers need to review and identify contractual obligations and restrictions early in the process.

Legal constraints may exist on the transfer of conserved water to other irrigators or water users inside or outside

of the district boundaries. A major function and benefit of water conservation programs is the ability to transfer conserved water from lower-valued uses to higher-valued uses (value may be reflected in political or social objectives as well as in monetary terms). Constraints on the transfer of water may severely limit the feasibility, benefits and success of an incentive pricing program.

COMMUNICATING WITH THE PUBLIC

The "public" includes local community leaders, representatives of related government agencies, individuals and various interest groups. Involving the public in the planning and implementation process provides a mechanism for obtaining broader perspectives on issues and can head off obstacles to program implementation. While a district may be reluctant to discuss internal matters with the public, there may be benefits from the communication such as better public understanding of the district and recognition that the district is trying to improve water use efficiency. This understanding may translate into better support for the district. District managers are also well aware that some interest groups have objectives that differ from water users in the district and managers feel guarded about providing information related to district operations. In any case, district management should review their specific legal obligations for communicating with and involving public interest groups.

Section Five -- District Characteristics and Goals

This section of the Pricing Handbook will help you gather some information about your district that is required to set rates. It will:

- ☞ Help you evaluate whether your district can use incentive pricing
- ☞ Help you obtain information about water use and costs in your district
- ☞ Help you set revenue and water conservation goals

EVALUATE DISTRICT FOR APPLICABILITY OF INCENTIVE PRICING

A number of factors can discourage a district from using incentive pricing. Some districts may face legal constraints while others may not have the ability to measure water deliveries. This discussion will help you determine if your district faces such limitations before you invest too much effort in preparing to set new rates.

If your district is already receiving some portion of its revenue from water rates then it is unlikely that your district is prevented from implementing further incentive pricing.

If your district has only a fixed charge rate schedule and faces any of the following constraints, limitations or obligations, you may want to continue with your current rate schedule until such time as the constraints can be removed.

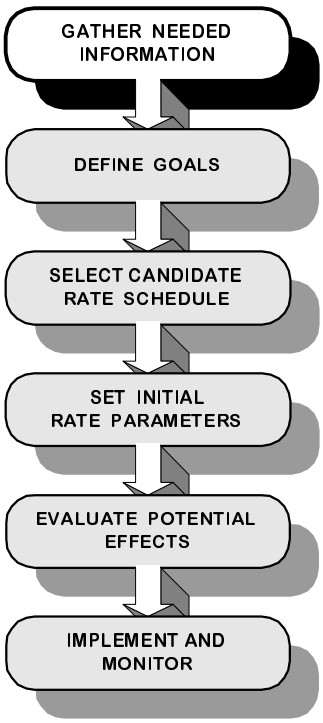
Legal Constraints: Your district cannot sell water to individual members, that is, state law prevents you from treating water as a commodity. You should consult your state Water Resources Department or other state regulatory agency to assess possible solutions to current legal barriers.

Technical Limitations & Administrative Costs: In order for incentive pricing to be successful, your district must monitor and record the amount of water delivered to each farmer. If your district does not have the required staff or water monitoring systems necessary to adopt per unit water rates you should remain with your current fixed charge rate schedule, until such capability has been obtained. However, keep in mind that the methods used to measure and monitor your district's water deliveries do not need to be highly sophisticated or technical. Alternative water measurement and accounting systems are discussed later in this section.

Contract Obligations: Your district may have a fixed-based contract that specifies an annual payment

independent of the total water delivered annually. This fixed payment requirement need not, however, preclude implementing incentive pricing. Although you may be concerned with revenue stability to meet existing contract obligations, initiating a rate schedule that includes a small portion of revenue being generated from water rates may not significantly sacrifice this goal.

DISTRICT CHARACTERISTICS



The objective of the next few pages is to guide the district through collection of district characteristics that are relevant to the rate-setting process. Much of this information can probably be obtained during the formulation of a Water Management Plan as described in the Water Management Guidebook. We anticipate that most of the information required by the Pricing Handbook will be available within the district itself or can be obtained from Reclamation's *Water Distribution Reports and Crop and Water Surveys*. Readers should also contact their Cooperative Extension Service offices, which may have some of the information needed for rate-setting. The Natural Resources Conservation Service also may be able to provide assistance to districts.

The Appendix contains blank worksheets and detailed, line-by-line instructions for entry and calculation of district data. Here we illustrate the information-gathering process with our example districts.

Define Your Base Year

The information we identify below should be representative of the conditions in your district before changing to incentive pricing. You should define a "base year" from which this information will be taken and against which changes in rates and water use will be compared. The base year should be a year in which the district operated under normal flows and weather

conditions and in which the district's historical rate schedule was in effect.

In general, you should pick as your base year the most recent year in which conditions were "normal" and in which your water measurement and accounting systems were in place. One exception to this is if your district has been preparing irrigators for the start of incentive pricing and some irrigators have already taken steps to reduce water use. Then you should pick an earlier year.

Water Deliveries

The amount of water delivered to farmers by the district is the focus of incentive pricing. You need to base decisions about pricing and subsequent monitoring and adjustment of your new water rates on your "normal" water deliveries. The first worksheet, Table 5.1, is where you would record your districts' normal annual water deliveries. Our example Districts A and B have annual deliveries of 120,000 acre-feet.

Table 5.1: District Water Deliveries Worksheet

Districts A and B	
Total Annual Deliveries (acre-feet)	120,000

Cost of Alternative Water Supplies

If farmers in your district can switch to alternative sources of water (such as private surface rights or groundwater) then water use, and hence district revenues, may decrease if rates are increased. Fill out the following table (Table 5.2) to provide information about alternative water supplies. Fill out a new line for each supply with a significantly different cost. (Remember, fill this out only for supplies that are not controlled by the district. Don't include district supplies.)

Table 5.2: Alternative Water Supply Worksheet

Districts A and B	
Available Annual Alternative Supply	**Average Cost ($/acre-foot)**
Minimum Cost ($/acre-foot)	

If irrigators in your district have a large number of alternative supplies available to them, try to estimate a range of costs for representative alternative supplies. Later, you will compare your new water rate to this list of alternative water supplies to determine if farmers would use them instead of district supplies after you increase your water rate. In our example Districts A and B, there are no alternative water supplies.

District Costs

Rates must be sufficient, when combined with other charges such as *ad valorem* taxes, to cover all district costs. Costs include not only repayment and O&M costs, but should also include depreciation of physical facilities.

Some districts have responsibilities beyond irrigation water supply. For example, your district may have flood control or recreation facilities. In such cases there may be other sources of funding to support these non-irrigation activities. Our focus in this Pricing Handbook is irrigation, but you cannot ignore costs and revenues attributable to other activities, particularly when those costs and revenues are not fully separable. In estimating district costs and revenues in this and subsequent sections, you may either lump all district operations together or separate them, and deal only with irrigation-related revenues and costs, whichever is easier for you. What is important is that you maintain a consistent approach--don't separate costs and lump revenues, for example.

*A **Replacement Reserve Fund** is an account used to accumulate money to pay for replacement of major facilities or equipment*

It is important to keep in mind that the district may have to replace physical facilities in the future. If the district has responsibility to fund such replacement then it should put aside money annually in amounts based on the expected cost and date of replacement. We call these contributions **Replacement Reserve Funds**. Districts that require replacement funds should consult with their accountants to set appropriate annual contributions.

When shifting revenue from fixed charges to water rates there is some chance that revenues will vary. It is important to provide a "safety factor" to insure that adequate revenues are available to cover district costs. When considering your safety factor, keep in mind which of your costs are "fixed," that is, they don't change (or only change a little) when your district delivers more or less water. If you put a water rate in place and your district's water use decreases, because of a dry year for example, there is some risk that you might not have enough revenues to cover these fixed costs.

Your district may have "variable" costs, too. Variable costs are costs that increase or decrease with water use. If your water rate is too small to cover these variable costs and your water use increases, you run the risk of not having enough revenues from fixed charges to cover all of these costs.

We have broken down district costs according to whether they are fixed or variable.

Fixed Costs

Fixed costs stay the same regardless of how much water your district delivers. Examples of fixed costs are repayment obligations (but not per-acre-foot charges under a supply contract), fixed payments under a water supply contract, administrative costs, maintenance costs (but not operational costs), insurance, interest on capital improvements and payments to a replacement reserve fund. Fixed costs for our two example districts are given in Table 5.3.

Table 5.3: Fixed Costs Worksheet

Districts A and B	
Total Repayment Obligation ($/year)	1,476,000
Administration & Maintenance Costs ($/year)	264,000
Replacement Reserve Fund ($/year)	0
Other Fixed Costs ($/year)	0
Total District Fixed Costs ($/year)	1,740,000

Variable Costs

Variable costs are costs that are pegged to the amount of water the district delivers. Examples are operational costs like pumping or water treatment, or per-acre-foot charges (water rates) from water supply contracts.

Enter your variable costs in Table 5.4 in the amount that would be incurred for the average conditions for your district.

Table 5.4: Variable Costs Worksheet

Districts A and B	
Total Annual Pumping Cost ($/year)	0
Total Annual Water Treatment Cost ($/year)	0
Other Variable Costs($/year)	0
Total District Variable Costs ($/year)	0

Rate Schedule

If your district charges irrigators for water deliveries, you will record that information in Table 5.5 below. The information you need here are things that show up on the farmer's bill. Thus, fixed charges on a farm or on acreage would be included here, as would unit water charges (per acre-foot or per application). You would not include *ad valorem* taxes in this table.

Water pricing information for our example districts is provided in Table 5.5.

If your district charges for each application of water, you will need to convert this rate into one expressed in dollars per acre-foot. Do this by first calculating the amount of water per application in acre-feet and then dividing this amount into the price per application. In calculating your water rate from an application basis, be sure not to include any fixed charges, since those are entered on a separate line.

Table 5.5: Water Pricing Information Worksheet

	District A	District B
Fixed Charge on Acreage ($/acre)	58	30
No-charge water (acre-feet)	0	0
First Block Rate ($/acre-foot)	na	7
Size of First Block (acre-feet)	na	no limit

Revenues

District revenues, from all sources, must be sufficient to cover costs. In the rate-setting process you will compare the revenues expected from new water rates with district costs. Here you should write down district revenues (Table 5.6).

Table 5.6: District Revenues Worksheet

	District A	District B
Total District Acreage	30,000	30,000
Revenue from Fixed Charges ($/year)	1,740,000	900,000
Revenue from Other Sources ($/year)	0	0
Revenue from Water Rates ($/year)	0	840,000
Total District Revenue ($/year)	1,740,000	1,740,000

As we noted above, if your district has multiple responsibilities, it may receive revenues from sources unrelated to irrigation water supply. You may include those revenues under *Revenue from Other Sources* but be sure that you also include any corresponding costs in Tables 5.3 and 5.4.

Water Measurement and Accounting Systems

An effective water measurement and accounting program is a prerequisite for implementation of incentive pricing. A district's measurement and accounting system should be capable of tracking the volume of water conveyed through the district's water delivery and distribution system to individual water users.

A reliable water measurement and accounting system enables districts to answer important questions such as:

? **Was the district conservation goal met, underachieved or overachieved?**

? **How did individual farmers alter water application under the revised rate schedule?**

? **Did inefficient water users cut back water deliveries more than others?**

For districts that don't have metering at farm headgates, a water measurement system sufficient for incentive pricing can be put in place using estimated flows. The district would estimate the rate of flow at the farmers headgate. Each time the farmer irrigates, the amount of water used would be calculated by multiplying the estimated flow rate by the duration of the irrigation. In order to be effective, estimates of flow rates must be acceptable to both the district and the irrigator.

Estimated flows should be checked for accuracy at every opportunity. One way to do this is to sum up all estimated deliveries and compare them to measured deliveries. Some districts may only be able to make such a comparison against total district deliveries but others may be able to make checks at different turnouts.

Though this method is imprecise compared to metering water at a headgate or turnout, it is sufficiently precise to serve as an interim basis for an incentive pricing system.

Regardless of the measurement system you use, it is important to remember that if your water conservation goal is relatively small you may have difficulty determining if, in fact, you have met your goal. This is because the natural variation in climate and precipitation affects water use and the imprecision inherent in most measurement systems may obscure, in any given year, the small reduction in water use. You may have to observe water use over several years to determine how irrigators are responding.

Water measurement and accounting is one of the fundamental water management measures identified by Reclamation. For more information on water measurement and accounting systems see the Water Management Guidebook.

System Scheduling

When incentive pricing is put in place farmers will require more flexibility in how they order water and how it is delivered to them. If you expect farmers to use water more efficiently you must provide them with the means to apply just the right amount of water at just the right time. The district should have facilities and procedures in place to allow for sufficient flexibility in ordering and delivery of water. Irrigation system scheduling is addressed in detail in the Water Management Guidebook.

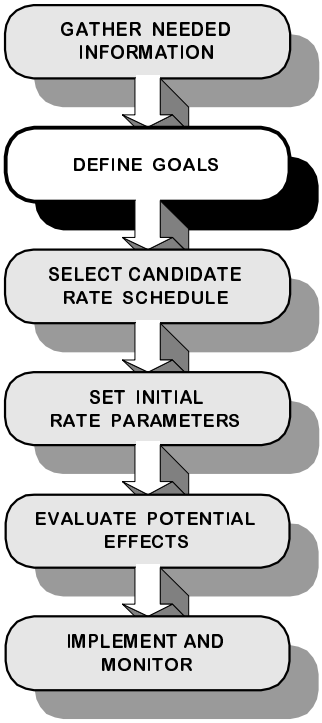
Bookkeeping and Accounting Systems

The district's bookkeeping and accounting system should be capable of generating bills that include charges for water use. It must properly account for irrigators' bills and their payments. It should be capable of producing regular and timely summaries of water use for inclusion on the bills in order to give irrigators the information they need to manage their water use. If you doubt that your district has this capability you should seek assistance from the Reclamation project area office near you.

Accuracy/Quality of Information

The accuracy with which you can set new water rates will depend on the quality of the information you have provided. If you have doubts about the quality of the information, then you should be cautious and conservative in using the results of the rate setting process.

DISTRICT GOALS



During the process of preparing a water conservation plan, your district must develop a set of goals to drive its water management planning effort. Although an incentive pricing program isn't likely to help you achieve all of your goals, it is extremely valuable in accomplishing certain types of water management goals. The objective of this discussion is to assist you in identifying which of your district's water management goals can best be accomplished through an incentive pricing program. The goals you identify here will guide the design of a rate schedule and will provide a "yardstick" against which the performance of the program can be compared.

This Pricing Handbook provides detailed direction for you to evaluate the effectiveness of rate schedules to help you achieve goals dealing with water conservation and revenue effects. These two types of goals can be evaluated numerically, using the information you have provided above and estimates of the effect of price changes. Other water management goals, such as equity, convenience, ease of understanding and so on are not suited to such a numerical evaluation. The Water Management Guidebook can provide you with some background and guidance in selecting and evaluating these other goals.

Water Conservation Goal

The rate-setting process requires that your water conservation plan includes, at a minimum, a water conservation goal and a revenue goal. Note that you can establish a water conservation goal of zero change if you wish only to change revenues. Likewise, you can select a revenue goal of zero change if you wish only to conserve water. If you wish to conserve water, your water conservation goal may consist of several parts. Some examples are:

- Reduce inefficient use of water

- Conserve water in normal years for carryover for future needs
- Conserve water in dry years (reduce demand); use rates to allocate available supply
- Reduce water use on farms with high water use and low-valued crops; transfer this water to other farms in the district
- Reduce water use on farms with high water use and low-valued crops; temporarily or permanently transfer this water to users outside district

Water rates have the flexibility to help you meet any or all of these goals. In this Pricing Handbook, we focus on setting rates that reduce the inefficient use of water. As you gain experience with water rates at your district, you can change your rate schedule to address other water management goals.

For calculating new water rates, you will need to distill your water conservation goal down to the percentage by which you would like to reduce your current water use. Enter the amount of water savings you wish to see, in percent, in Table 5.7 below. You may enter zero for your water conservation goal.

Table 5.7: Water Conservation Goal Worksheet

Districts A and B	
Desired Water Savings (%)	5

Revenue Goal

Your district may wish to increase revenues to fund on-farm water conservation practices, cover replacement of capital facilities, pay for conservation-oriented expenses or other reasons. Or, your district may wish to maintain revenues at current levels while encouraging increased efficiencies. Enter the amount of revenue increase you wish to see, in percent, in Table 5.8 below. Note that you may enter zero for your revenue goal.

Table 5.8: Revenue Goal Worksheet

Districts A and B	
Desired Revenue Increase (%)	5

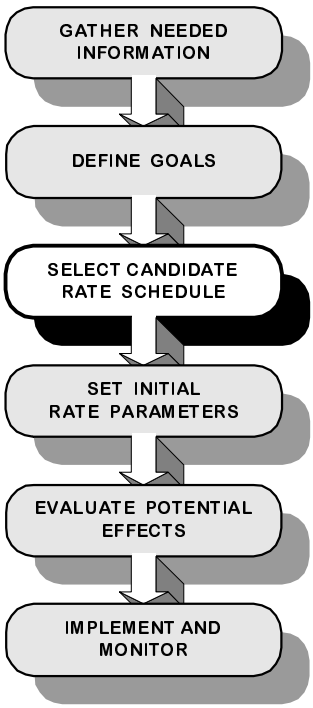
Section Six -- Designing a New Rate Schedule

This section of the Pricing Handbook will guide you in setting up a conservation rate schedule tailored for your district. It will

- ☞ Help you select a candidate rate schedule
- ☞ Help you set your fixed charge and water rate
- ☞ Help you evaluate the potential effects of the new rate schedule

To illustrate these steps, we will continue to use the example districts you have become familiar with in Sections Three through Five.

SELECT A RATE SCHEDULE



This step involves establishing a conservation rate schedule tailored to your district. The type of schedule we will suggest will be a small variation from your current rate schedule; therefore, your district's current rate schedule is a key factor.

Your current rate schedule will fall into one of four categories:

1. Fixed charge only
2. Combination of Fixed Charge With Water Rate
3. Uniform Water Rate With No Fixed Charge
4. Tiered Block Rate

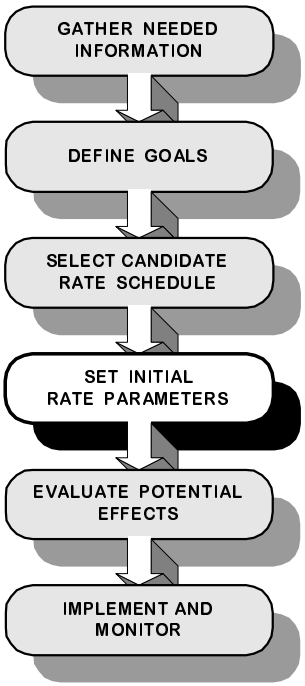
Table 6.1 shows our recommendations for your new rate schedule.

Table 6.1: Selecting a Rate Schedule

If the Current Rate Schedule is:	Consider the Following Schedule:
Fixed charge only	Combination fixed charge with water rate
Combination fixed charge with low water rate	Combination fixed charge with higher water rate
Combination fixed charge with high water rate	Tiered block rate
Uniform water rate with no fixed charge	Tiered block rate

If your district has a fixed charge and a high water rate or a uniform water rate with no fixed charge (the shaded cells in the table) we recommend that you consider a tiered block rate. You should set rates according to the instructions that follow, but then also execute the instructions in the Appendix under *Advanced Topics: Tiered Pricing.*

SET YOUR FIXED CHARGE AND WATER RATE



Once the candidate rate schedule is chosen, the district must determine the specific values of the initial rate parameters, the fixed charge and the water rate. These values will depend upon the district's revenue and water conservation goals as well as the current rate schedule. This stage has five steps:

1. Calculate the Current Response Price
2. Calculate the New Response Price Required to Meet Your Water Conservation Goal
3. Calculate the New Water Rate
4. Calculate the New Fixed Charge
5. Adjust the Fixed Charge to Provide a Free Water Block

Step 1: Calculate the Current Response Price

In Section Two, we explained that the farmer responds to a combination of both the farm average price and the water rate. We defined the response price as a measure of this combination. The district-wide response price is the average of the current district average price and the current water rate. In Table 6.2 we calculate the current response price for example Districts A and B.

District A's current rate schedule has only a fixed charge rate component, so the response price is simply half of the District Average Price. The *Current District Average Price* in Table 6.2 is calculated by dividing the district's *Total Revenues* by its *Total Water Deliveries*. To get the

Current District Response Price, average the current *District Average Price* with the *Water Rate*. Since the *Water Rate* in this case is zero, the *District Response Price* is one-half of the current *District Average Price*, or $7.25 per acre-foot.

District B's current rate schedule has both a fixed charge component and a water rate component. Therefore, the total revenues that are used to calculate the district average price include revenues from fixed charges and water rates. The response price for District B is the average of the *Current Water Rate* and the *Current District Average Price*, or $10.75, per acre-foot.

Table 6.2: Current District Response Price Worksheet

	District A	District B
Current Water Rate ($/acre-foot)	0.00	7.00
Current Fixed Charge ($/acre)	58.00	30.00
Current Total District Revenue ($)	1,740,000	1,740,000
Current Total Water Deliveries (acre-feet)	120,000	120,000
Current District Average Price ($/acre-foot)	14.50	14.50
Current District Response Price ($/acre-foot)	7.25	10.75

The *Current District Response Price Worksheet* and detailed line-by-line instructions are found in the Appendix.

Step 2: Calculate the New Response Price to Meet Your Conservation Goal

Remember from the discussion in Section Two that irrigators will usually decrease water use in response to an increase in the price of water. In Section Two we also showed you how you can use elasticity to estimate how much irrigators will cut back water use after the response price has been increased. You can apply these principles to figure out how much you need to change your response price to meet your conservation goal.

Although we are assuming that farmers will respond to increases in the response price by reducing water use, in

general we expect this reduction in water use to be small. In order to illustrate the effect of elasticity on water rates, we have assumed that example District A has an elasticity of 0.10 and example District B has an elasticity of 0.15. If you are concerned about the effect water rates will have on district revenues, consider using an elasticity of 0.20.

Calculation of new response prices for our two example districts is shown in Table 6.3.

Table 6.3: New Response Price Worksheet

	District A	District B
Conservation Goal (%)	5% = 0.05	5% = 0.05
Desired Change in Water Deliveries (acre-feet)	6,000	6,000
Desired Water Deliveries (acre-feet)	114,000	114,000
Elasticity	0.10	0.15
Required Change in Response Price (%)	50% = 0.50	33% = 0.33
Change in Response Price ($/acre-foot)	3.63	3.58
New District Response Price ($/acre-foot)	10.88	14.33

Calculate the *Required Change In Response Price* by dividing the *Conservation Goal* by the *Elasticity*. For District A, the calculation is 100 x 0.05/0.1 = 50%. When you know the required change in the response price you can then multiply it by the current response price to get the *Change In Response Price*. For District A, the calculation is 0.50 x $7.25/acre-foot = $3.63/acre-foot.

The *New District Response Price* is then the sum of the *Change In Response Price* and the *Current District Response Price* from Table 6.2.

The *New Response Price Worksheet* and detailed line-by-line instructions are found in the Appendix. When you work through the worksheet, use the elasticity that is appropriate for your district, based on its current rate schedule.

Step 3: Calculate the New Water Rate

Once you know the new response price for your district, you can calculate a new water rate. This is done in two steps:

1. Calculate the new district average price by dividing your new revenue goal by your new water use goal.

2. Calculate the new water rate by reversing the calculation you used to get the response price.

Remember that the response price is equal to the average of the district average price and the water rate.

RESPONSE PRICE = (DISTRICT AVERAGE PRICE + WATER RATE)/2

We can turn that formula around and use it to calculate the water rate:

WATER RATE = (RESPONSE PRICE X 2) - DISTRICT AVERAGE PRICE

The actual calculations for our two example districts are shown in Table 6.4.

Table 6.4: New Water Rate Worksheet

	District A	District B
Revenue Goal (%)	5% = .05	5% = .05
Desired Change in Revenues ($)	87,000	87,000
Desired Total District Revenues ($)	1,827,000	1,827,000
New District Average Price ($/acre-foot)	16.03	16.03
New Water Rate ($/acre-foot)	5.73	12.63

First calculate the dollar amount of revenue increase that you need to meet your revenue goal by multiplying your revenue goal (a percentage) by your current revenues. For Districts A and B this works out to $1,740,000 x 0.05 = $87,000. Then, add the *Desired Change in Revenues* to current revenues to get the *Desired Total District Revenues*.

For Districts A and B, the calculation is $1,740,000 + $87,000 = $1,827,000.

Remember that if you don't wish to increase revenues your revenue goal will be zero, so your new revenues will equal your old revenues.

From your new revenues and your new water delivery goal, you can calculate the *New District Average Price*. For Districts A and B this works out to $1,827,000/114,000 acre-feet = $16.03/acre-foot.

Calculate the *New Water Rate* by multiplying the *New District Response Price* by two and subtracting the *New District Average Price*. For District A this is (2 x $10.88/acre-foot) - $16.03/acre-foot = $5.73/acre-foot. For District B the *New Water Rate* is $12.63/acre-foot.

The *New Water Rate Worksheet* and detailed line-by-line instructions are found in the Appendix.

Step 4: Calculate the New Fixed Charge

Finally, calculate the new fixed charge (Table 6.5). Subtract the revenues generated by the new water rate from the revenue goal you have set. This gives the revenues that you must get from fixed charges. To get the per-acre charge, just divide the fixed-charge revenues by the total district irrigated acreage.

Table 6.5: New Fixed Charge Worksheet

	District A	District B
New Water Rate Revenues ($)	653,220	1,439,820
Fixed Charge Revenue Requirement ($)	1,173,780	387,180
Total District Acreage in Production (acres)	30,000	30,000
New Fixed Charge ($/acre)	39.13	12.91

For District A the *New Water Rate Revenues* are $5.73/acre-foot x 114,000 acre-feet = $653,220. Find the *Fixed Charge Revenue Requirement* by subtracting the *Water Rate Revenues* from the revenue goal (Table 6.4), $1,827,000 - $653,220 =

$1,173,780. Then the *New Fixed Charge* for District A is $1,173,780/30,000 acres = $39.13/acre.

Similarly District B's new fixed charge drops to $12.91/acre.

The *New Fixed Charge Worksheet* and detailed line-by-line instructions are found in the Appendix.

Step 5: Adjust the Fixed Charge to Provide a Free Water Block

You may desire to offer a specified amount of water that is not subject to your new water rate. Farmers would receive this allotment of water in return for payment of the fixed charge, without any additional charge for its delivery. If you would like such a "free water" allocation to be part of your new rate schedule, then the new fixed charge you calculated above must be adjusted upwards so that you can still meet your revenue goal.

A worksheet is provided in Table 6.6 to show how a free water allotment would work in District A.

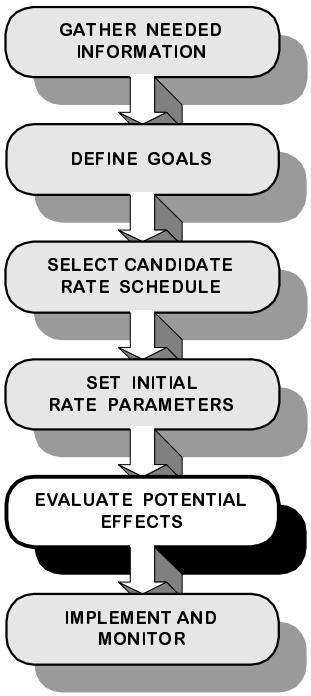
Table 6.6: Free-Water Worksheet

District A	
Free-Water Allotment (acre-feet/acre)	2
Required Increase in Fixed Charge ($/acre)	11.46
Adjusted Fixed Charge ($/acre)	50.59

The *Required Increase in Fixed Charge* is 2 acre-feet/acre x $5.73/acre-foot = $11.46/acre. The new *Adjusted Fixed Charge* is $11.46/acre + $39.13/acre = $50.59/acre.

EVALUATE POTENTIAL EFFECTS

Is Your New Rate Schedule Realistic?



You have now set new water rates to meet your revenue and water conservation goals. As we discussed in Section Two, the response of farmers to the new water rates cannot be predicted with certainty, so the actual amount of water conservation that results from the new rates could be more or less than your goal. In this discussion we suggest that, before implementation, you review the amount of water you anticipate the farmers would use in response to this new rate schedule. If you think their water use may decrease more than your conservation goal, then we will recommend revisiting the rate-setting process using a higher value of elasticity.

Compare to Cost of Alternative Supplies

Review the *Alternative Water Supply Worksheet* (Table 5.2) in Section Five. If your water rate is less than the minimum cost of alternative supplies then it is unlikely that irrigators will turn to alternative supplies as a result of the new rate. If irrigators are already using alternative supplies (for whatever reasons), you need to evaluate if your rate increase would affect irrigators' reliance on those alternative sources. If your new rate is greater than the minimum cost of alternative water, you need to make an estimate of roughly how much of the alternative supplies irrigators will use once you have put your rates in place. You can do this by totaling the amount of water supply available to irrigators at a cost less than your new water rate.

Estimating Change in Irrigation Use

Separate from your estimate of the use of alternative supplies, you will need to estimate how much actual

water conservation will take place in response to your new water rate. In making this estimate consider:

- Your current rate schedule
- Your new rate schedule
- Characteristics of your district that affect elasticity, particularly the net value of water used on low-valued crops

In determining your anticipated change in water deliveries you should determine if some crops in your district have values less than the water rate in your rate schedule. If such crops exist, you may want to consider, based on your knowledge of the district, how farmers producing those low-valued crops will respond to the new water rate.

Evaluation of Elasticity

Review your new water rate and consider, as a reality check, how the farmers in your district will respond. If you believe that, in response to your new rate schedule, farmers as a group will reduce water use by an amount *less than or equal to* the amount desired, district revenues may exceed your desired revenue goal during the first couple of years after implementation.

If you believe that farmers' reduction in water use will be *more than* the amount desired, consider an adjustment to the elasticity value used in the previous chapter. To evaluate elasticity for your district use Table 6.7, the *Elasticity Adjustment Worksheet.* First sum your estimates of water use reductions arising from farmers switching to alternative water supplies and from farmers changing water use on low-valued crops. From that sum calculate the *Anticipated Change in Water Deliveries* and calculate the *Anticipated Elasticity* by dividing the *Anticipated Change in Water Deliveries* by the *Required Change in Response Price* (Table 6.3).

Table 6.7: Elasticity Adjustment Worksheet

Anticipated Change in Water Deliveries (acre-feet)	
Anticipated Change in Water Deliveries (%)	
Anticipated Elasticity	

Recalculate the Components of Your New Rate Schedule

If your *Anticipated Elasticity* is more than 25% larger than the elasticity we suggested for calculating your new water rates, then:

1. Replace the elasticity value that we suggested with the *Anticipated Elasticity* you just calculated. Your anticipated elasticity should not be greater than 0.5. (Even when there is substantial overuse of water, studies of irrigation have shown that it is highly unlikely that elasticity will be greater than 0.5).

2. Recalculate the water rate and fixed charge using your *Anticipated Elasticity.*

You should end up with a lower water rate and higher fixed charge than you got in your first pass through. If you are satisfied that the expected water use reduction is realistic, proceed with the remainder of this evaluation.

How Does the New Rate Schedule Affect Water Bills?

Your new rate schedule will change water bills in your district. Water users will respond to these changes by adjusting their water use as we have discussed in Section Two and this section. For incentive pricing to be successful, the changes to water bills must be reasonable. Ideally, in most cases you would like the water bills of frugal water users to decrease, water bills of medium water users to stay about the same and water bills of excessive water users to increase. Overall, the average water bill in your district should not increase by more than 20% in any year.

If you accomplish this with your water rates it is likely that incentive pricing will be accepted by the majority of your

water users. As we have noted before, the issue of equity has been a significant factor in the acceptance of incentive pricing in districts where it has been adopted. Efficient water users like to know that they are not paying for water used by excessive water users.

The following worksheets (Tables 6.8 through 6.10) are designed to help you estimate the impact of the new rate schedule on the different types of water users in your district. You can fill this worksheet out for water users to demonstrate how new rates would affect them, or you could provide the worksheet to them and let them fill it out themselves.

To illustrate the effect of the new rate schedule on farmers' bills, let's consider the impact on low, medium and high water users. First consider a medium water user in District A who uses 3 acre-feet per acre (Table 6.8).

Table 6.8: Bill Impact Worksheet - Medium Water User

Current Water Bill	
Current Fixed Charge ($/acre)	58.00
Annual Water Use (acre-feet/acre)	3
Current Water Rate ($/acre-foot)	0
Current Water Rate Bill ($/acre)	0
Total Current Bill ($/acre)	58.00
New Water Bill	
New Fixed Charge ($/acre)	39.13
New Water Rate ($/acre-foot)	5.73
New Water Rate Bill ($/acre)	17.19
Total New Bill ($/acre)	56.32
Difference in Bill ($/acre)	-1.68

The medium water user's bill drops by 3%. The high water user (4 acre-feet per acre) is affected more dramatically, as shown in Table 6.9.

Table 6.9: Bill Impact Worksheet - High Water User

Current Water Bill	
Current Fixed Charge ($/acre)	58.00
Annual Water Use (acre-feet/acre)	4
Current Water Rate ($/acre-foot)	0
Current Water Rate Bill ($/acre)	0
Total Current Bill ($/acre)	58.00
New Water Bill	
New Fixed Charge ($/acre)	39.13
New Water Rate ($/acre-foot)	5.73
New Water Rate Bill ($/acre)	22.92
Total New Bill ($/acre)	62.05
Difference in Bill ($/acre)	+4.05

The high water user has a 7% increase in his water bill and so has considerable incentive to cut back water use. Finally, the low water user (using 2 acre-feet per acre) sees a lower water bill as shown in Table 6.10.

Table 6.10: Bill Impact Worksheet - Low Water User

Current Water Bill	
Current Fixed Charge ($/acre)	58.00
Annual Water Use (acre-feet/acre)	2
Current Water Rate ($/acre-foot)	0
Current Water Rate Bill ($/acre)	0
Total Current Bill ($/acre)	58.00
New Water Bill	
New Fixed Charge ($/acre)	39.13
New Water Rate ($/acre-foot)	5.73
New Water Rate Bill ($/acre)	11.46
Total New Bill ($/acre)	50.59
Difference in Bill ($/acre)	-7.41

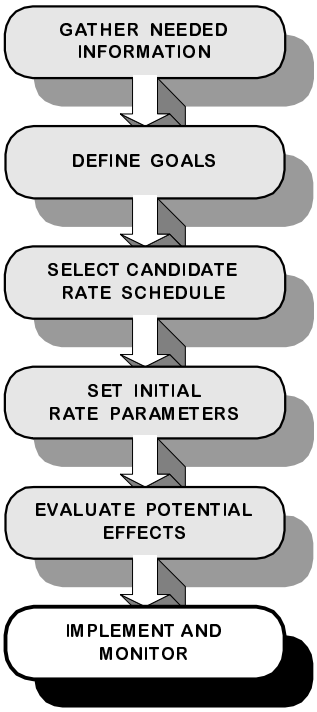
The low water user has a reduction in his water bill of almost 13%.

Section Seven -- Implementation & Monitoring

This section of the Pricing Handbook will guide you through the process of putting your new rate schedule into effect. It will:

- ☞ Provide an initial rate schedule for the first year
- ☞ Provide for adjustments to your fixed charge during an evaluation period
- ☞ Guide you in evaluating the performance of your rate schedule
- ☞ Provide you with a procedure to re-evaluate the elasticity in your district
- ☞ Guide you through the re-calculation of your rates, if necessary

A FOUR-YEAR PHASE-IN PLAN FOR INCENTIVE PRICING



In Section Six you designed a rate schedule that is expected to satisfy both your conservation and revenue goals. The components of this rate schedule include a higher water rate and a lower fixed charge than what you used in the past. The initial values for these components were calculated based on the presumption that, as a group, farmers will in fact respond as suggested by the expected elasticity value.

While this elasticity value is the best initial guess of how farmers might respond to the increased water rate, once the conservation rate schedule is implemented, actual farmer response may be higher or lower than expected. In this section we will provide guidance for phasing in your rate schedule over a number of years. Each year, as additional information regarding your farmers' reactions to changing water prices becomes available, you will make adjustments to the components of the rate schedule.

The movement to incentive pricing will put the district in a position where it is more dependent on water rate revenues and less dependent on fixed charge revenues. This means that the district's total revenues are more dependent on actual water deliveries (variable) and less dependent on acreage in production (fixed).

There are two major sources of variability in revenues:

1. Water supplies to the district could be above or below what is expected

2. Farmers' actual responses to the change in water rates are above or below what is expected

Because revenues from fixed charges serve as a stable source of revenues and because water deliveries vary from year to year, the district should consider phasing in the new water rate and fixed charge over a minimum four-year period.

A result of this phased in process is that you will accumulate increased revenues. These accumulated revenues can be returned to farmers as rebates, used to fund on-farm conservation programs, retained as a hedge against drought, or some combination of the three.

High Response to Water Rates

If your water users reduced water use more than you expected, then:

- Your revenues are lower than expected, and
- You have exceeded your conservation goal

This means that elasticity in your district may be higher than the value used in Section Six.

To remedy this situation, your rate schedule should have a higher fixed charge and a lower water rate. After you know how the water users are going to respond, you can re-set your rate schedule, using the methods in Section Six, but using a higher elasticity. Alternatively, if the farmer response is not too great, you can leave your water rate at the design level and adjust your fixed charge to obtain the revenues you require.

Low Response to Water Rates

If your water users reduced water use less than you expected, then:

- Your revenues are higher than expected, and
- You have not met your conservation goal

This means that elasticity in your district may be lower than the value used from Section Six. In response to this situation, your rate schedule should be modified to have a lower fixed charge and a higher water rate. You can also take steps to increase the ability of farmers to use

water more efficiently, effectively increasing elasticity in your district.

Additional revenues generated from water rates during the phase-in period can be used to:

- Fund a low-interest loan program, cost sharing, or a grant program that would be available to fund on-farm conservation practices in your district
- Mitigate farmer bill impacts through rebates

As on-farm conservation practices are put into place, water use will decrease. Once you understand how the water users are going to respond, you can re-set your rate schedule, using the methods in Section Six, but using a lower elasticity.

Ongoing Adjustment

The steps we outline below will help you introduce rates to your district smoothly. You should not think of this as a one-time process. You should be adjusting your rates periodically to maintain them at the best level.

Water Measurement and Accounting

During each step of implementation the district must accurately record all modifications to the existing rate schedule, as well as farmers' responses to each alteration. If not already in place, a district must devise a water measurement and accounting system. See Section Five and the Water Management Guidebook for further discussion.

Outline of Implementation Steps

The process of putting your rates into effect involves two steps:

Step 1. Observe water users' response to water rates

Step 2. Adjust water rates

This process is outlined below in three phases intended for use when you first begin using water rates. The process should take at least four years. However, drought years can prolong the process. The three phases are presented in Table 7.1.

Table 7.1: Phases of Implementation

Phase One	Phase Two		Phase Three
Year 1	Year 2	Year 3 (or more)	Year 4 (or more)
Put initial rate schedule in place, using average of old and new water rate & current fixed charge	Retain initial average water rate & reduce fixed charge	Retain initial average water rate & further reduce fixed charge	If response is as expected, put complete rate schedule in place, otherwise re-calculate rates based on actual response

Phase One

In Phase One you will put an initial rate schedule in place. Phase One starts with the beginning of the first year in which water rates are put into effect. In Phase One you will:

- Put a new water rate into effect that is the average of the rate determined in Section Six and your existing water rate. If you have no current water rate, the initial rate will be one-half of the water rate determined in Section Six
- Leave your current fixed charge in place

By maintaining old fixed charges in the first year of implementation, the district will be assured that revenues will be collected in excess of the revenue goal. These excess revenues will cushion any underestimation of the

response of your farmers to water rates. By using one-half of your new target water rate you will keep the response price close to what was used in setting your rates.

Table 7.2 demonstrates the calculations for our example districts. A blank worksheet and detailed line-by-line instructions are found in the Appendix.

Table 7.2: Initial Rate Schedule Worksheet

	District A	District B
Current Fixed Charge ($/acre)	58.00	30.00
Current Water Rate ($/acre-foot)	0	7.00
Target Water Rate ($/acre-foot)	5.73	12.63
Initial Water Rate ($/acre-foot)	2.87	9.82

The current and initial fixed charges are the same in the first year (Phase One). At the end of the first year you will evaluate water use in the district. We don't expect too much change in water use this first year because short-run elasticity is low. We will have to wait at least another year to get a better idea of how water use will respond to the new rate schedule. Next year you will simply adjust your fixed charge to compensate for the excess revenues collected in the first year.

Phase Two

Phase Two begins at the start of the second year after you put your initial water rates in place. In Phase Two you will:

- Observe the response of irrigators to the new, initial rate schedule
- Make adjustments to your fixed charge to reflect excess revenues collected

You need to observe water use for a minimum of two years with normal water supply conditions. For this reason Phase Two can be as short as two years or can be several years in length.

At the beginning of Year 2 reduce the fixed charge by one-half of the excess revenues collected in Year 1. The amount by which you adjust your fixed charge is open to your judgment. You can adjust your fixed charge by the entire amount of excess revenues, if you so desire, though doing so will eliminate any cash reserves for future years. Note that in Phase Two you should not, for any reason, reduce your fixed charge below the one selected in Section Six.

Use the following worksheets for the two years recorded during Phase Two.

The calculations for our example districts are demonstrated in Table 7.3. A blank worksheet and detailed line-by-line instructions are found in the Appendix.

For District A, we began Year 1 with our initial water rate and fixed charge. Note that in this first year we collected our normal revenues from fixed charges (*Previous Year Fixed Charge Revenues*). As a result of the new rate schedule water deliveries dropped to 117,600 acre-feet (*Previous Year Water Deliveries*). Revenues from water rates in Year 1 totaled $337,512, bringing total revenues to $2,077,512, which were $250,512 greater than our desired revenues. This works out to $250,512/30,000 acres = $8.35/acre. We use one-half of the excess revenues, $4.18/acre, to reduce the fixed charge. The *New Fixed Charge* is $58/acre - $4.18/acre = $53.82/acre.

At the start of Year 3, we look back at Year 2 (in our example Year 2 had "normal" water supplies). Our water rate remained at $2.87/acre-foot, but our fixed charge was $53.82/acre, following the adjustment at the start of Year 2. Water use drops further to 116,880 acre-feet. The combined result of reduced fixed charge and reduced water use is that excess revenues are reduced by half, to $4.10/acre. Half of that, $2.05/acre, is used to reduce the fixed charge. The *New Fixed Charge*, used in Year 3, is $53.82/acre - $2.05/acre = $51.77/acre.

Table 7.3: Rate Adjustment Worksheet

Example District A	Year 2	Year 3
Initial Water Rate ($/acre-foot)	2.87	2.87
Previous Year Water Deliveries (acre-feet)	117,600	116,880
Previous Year Water Rate Revenues ($)	337,512	335,446
Total District Acreage in Production (acres)	30,000	30,000
Previous Year Fixed Charge ($/acre)	58.00	53.82
Previous Year Fixed Charge Revenues ($)	1,740,000	1,614,600
Previous Year Total Revenues ($)	2,077,512	1,950,046
Revenue Goal ($)	1,827,000	1,827,000
Excess Revenues ($)	250,512	123,046
Excess Revenues ($/acre)	8.35	4.10
Fixed Charge Adjustment ($/acre)	4.18	2.05
New Fixed Charge ($/acre)	53.82	51.77
Example District B	**Year 2**	**Year 3**
Initial Water Rate ($/acre-foot)	9.82	9.82
Previous Year Water Deliveries (acre-feet)	113,280	111,120
Previous Year Water Rate Revenues ($)	1,112,410	1,091,198
Total District Acreage in Production (acres)	30,000	30,000
Previous Year Fixed Charge ($/acre)	30.00	26.91
Previous Year Fixed Charge Revenues ($)	900,000	807,300
Previous Year Total Revenues ($)	2,012,410	1,898,498
Revenue Goal ($)	1,827,000	1,827,000
Excess Revenues ($)	185,410	71,498
Excess Revenues ($/acre)	6.18	2.38
Fixed Charge Adjustment ($/acre)	3.09	1.19
New Fixed Charge ($/acre)	26.91	25.72

The same procedures are used for District B, but it has a larger water rate and smaller fixed charge to begin with.

By the end of the second year we would expect to begin to see some response to incentive pricing. The response will almost certainly be incomplete--it may take several years for farmers to completely adjust to the new prices.

At the beginning of each subsequent year in Phase Two you will adjust your fixed charge according to the Phase Two *Rate Adjustment Worksheet*, as shown in Table 7.3.

Phase Two ends when you have experienced two years in which the district had sufficient water supplies to meet its required deliveries (including your conservation goal). This gives sufficient time for irrigators to respond to the new rate schedule and insures that you will have at least two years where water supply conditions did not distort their response.

Phase Three

In Phase Three you evaluate the irrigators' response to the new rate schedule. If the response is as you expected, then put in place both the water rate and the fixed charge selected in Section Six. If response is substantially different than what you expected (you overshot or undershot your water conservation goal) then you will need to estimate the actual elasticity of water in your district from the actual response of your farmers and re-calculate your rates based on that elasticity.

If the percentage difference between your expectation of irrigators' response and their actual response is greater than 50%, you should recalculate the elasticity in your district as described later in this section. Then re-calculate your rates as described in Section Six using this new elasticity value. If the percentage difference is less than 50%, you should adjust your fixed charge to compensate for the difference in revenues. Use the worksheet in Table 7.4 to adjust your fixed charges. The worksheet demonstrates the calculations for our example districts. A blank worksheet and detailed line-by-line instructions are found in the Appendix.

The calculation you are making here is similar to the one you made in Section Six to set your fixed charge in the first place. Now you have a better idea of what your revenues from water rates will be. You can use your *Actual Water Deliveries* from the end of Phase Two and your *New Water Rate* from Section Six to calculate the revenues you expect from water rates. Then, subtract those revenues from your *Revenue Goal* to get the revenues you must generate by fixed charges. Divide

that amount by the total acres in the district to get the per-acre fixed charge.

You might expect that water use will decline more when the new water rate is put into effect fully. This is probably true, but the effect should be small because we have kept the response price fairly constant during our phase-in period. Nevertheless, you may wish to be conservative in setting your fixed charge and make the necessary reduction over a few years.

Table 7.4: Adjust Fixed Charges Worksheet

	District A	District B
Revenue Goal ($)	1,827,000	1,827,000
Actual Water Deliveries (acre-feet)	115,200	110,400
Water Rate ($/acre-foot)	5.73	12.63
Water Rate Revenues ($)	660,096	1,394,352
Required Fixed Charge Revenues ($)	1,166,904	432,648
Total District Acreage	30,000	30,000
New Fixed Charge ($/acre)	38.90	14.42

Calculating the Actual Elasticity

Now that you have some idea about how much water use will be reduced by your new rate schedule, you can calculate the actual elasticity based on your price change and the actual conservation response of your district. The following worksheet (Table 7.5) illustrates the calculations for our two example districts. A blank worksheet and detailed line-by-line instructions are found in the Appendix.

Table 7.5: Actual Elasticity Worksheet

	District A	District B
Change in Response Price (%)	50% = 0.50	33% = 0.33
Actual Water Conservation Amount (acre-feet)	4,800	9,600
Normal Water Deliveries (acre-feet)	120,000	120,000
Water Use Change (%)	4% = 0.04	8% = 0.08
Actual Elasticity	0.08	0.24

Elasticity is calculated by dividing the percentage change in water use by the percentage change in the response price. For District A, the elasticity is 0.04/0.50=0.08. For both districts our conservation goal was 6,000 acre-feet. Water savings in District A undershot the goal while those in District B overshot the goal. Thus, actual elasticity in District A was less than expected (0.08 compared to 0.10) while the actual elasticity in District B was greater than expected (0.24 compared to 0.15).

Re-calculating the Rate Schedule

If you have overshot or undershot your conservation goal by 50% or more, we recommend that you recalculate rates for your district using the actual elasticity for your district. Then return to Section Six and recalculate rates, using your actual elasticity in the *New Response Price Worksheet*.

In our example above, we would recommend to District B that they recalculate their rates using an elasticity of 0.24.

Appendix

GLOSSARY

Accountability: Incentive pricing lets farmers make their own decisions. When the farmer's bills track the costs directly attributable to his or her actions, the farmer receives better signals regarding the district-wide consequences of those actions. If under these circumstances the farmer feels it is still worth it to act, the benefits he or she receives are at least as great as the costs.

Acre-foot: A volume of water that would cover one acre to a depth of one foot, or 325,850 gallons of water.

Application rate: Rate that water is applied to a given area. Usually expressed in inches of depth per hour.

Average price: The total revenue divided by the total acre-feet of water delivered.

Average value: Economic return to water.

Base year: A year in which the district experienced "typical" or "normal" water supply and water use conditions. This year is used as the basis for calculating water rates and as a point of comparison to evaluate the effectiveness of a new rate schedule.

Block: The volume of water to which a specific water rate is applied. In the case of a two-block (tiered) rate schedule, a certain level of deliveries in the first block may be purchased at a specified cost, the first block water rate. Deliveries greater than the first block level are subject to a higher water rate.

Capital fund: An account used to accumulate money for use to replace major facilities or equipment.

Conservation: Increasing the efficiency of energy use, water use, production, or distribution.

Crop irrigation requirement: Quantity of water, exclusive of effective precipitation, that is needed for crop production.

Demand scheduling: Method of irrigation scheduling whereby water is delivered to users as needed and which may vary in flow rate, frequency and duration. Considered a flexible form of scheduling.

Distribution system: System of ditches, or conduits and their appurtenances, which conveys irrigation water from the main canal to the farm units.

District: An entity that has contracts for the delivery of irrigation water. Such entities include, but are not limited to: canal companies, conservancy districts, ditch companies, irrigation and drainage districts, irrigation companies, irrigation districts, reclamation districts, service districts, storage districts, water districts, and water users associations.

District average price: The total district revenue divided by the total acre-feet of water delivered.

Ditch: Constructed open channel for conducting water.

Elasticity: The ratio of how much water use will change for a given price change. The changes in water use and price are measured in percent.

Equity: With per-acre-foot water rates, farmers are accountable for paying for their own water applications.

Farm average price: The farmer's water bill divided by the acre-feet of water delivered to the farmer. Under this definition, the water bill may simply be a fixed charge.

Farm loss: Water delivered to a farm which is not made available to the crop to be irrigated.

Fixed charge: A fee assessed to landholdings or acres in production. The fee may also be in the form of a tax assessed on property values. Typically, fixed charges are measured in dollars per acre per year.

Fixed-charge-only schedule: The farmer is allotted a certain amount of water and pays a fee regardless whether the entire allotment is used. Or, the farmer is assessed a fixed charge per acre of landholdings, in return for which the farmer receives any level of deliveries.

Groundwater: (1) Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper level of the saturated zone is called the water table. (2) Water stored underground in rock crevices and in the pores of geologic materials that make up the earth's crust. That part of the subsurface water which is in the zone of saturation; phreatic water.

Incentive pricing: Setting water rates that encourage efficient use of water.

Incremental water rate: The water rate applied to deliveries in the last block. Suppose a district had two blocks. The incremental water rate can be viewed as

how much district revenues would change if an additional acre-foot of water were delivered to a farmer.

Irrigation efficiency: The ratio of the average depth of irrigation water that is beneficially used to the average depth of irrigation water applied, expressed as a percent. Beneficial uses include satisfying the soil water deficit and any leaching requirement to remove salts from the root zone.

Irrigation frequency: Time interval between irrigations.

Long-run: The time period spanning multiple growing seasons.

Multiple block (tiered) rate schedule: The incremental water rate increases with successively higher levels (blocks) of water use. Water rates may or may not be accompanied by a fixed charge.

Net economic benefits: Economic benefits minus economic costs.

Operational losses: Losses of water resulting from evaporation and seepage.

Operational waste: Water that is lost or otherwise discarded from an irrigation system after having been diverted into it as part of normal operations.

Rate schedule: The combination of fixed charges and water rates that make up the district's pricing policy.

Replacement reserve funds: An account used to accumulate money to pay for replacement of major facilities or equipment**.**

Response price: The average of the district-wide average price and the water rate.

Return flow: That portion of the water diverted from a stream which finds its way back to the stream channel, either as surface or underground flow.

Revenue enhancing: A change in a rate schedule that increases the district's total revenues.

Revenue neutral: A change in a rate schedule that does not change the district's total revenues.

Runoff: The portion of precipitation, snow melt, or irrigation that flows over the soil, eventually making its way to surface water supplies.

Seepage: The movement of water into and through the soil from unlined canals, ditches, and water storage facilities.

Short-run: The time period within a particular growing season.

Surface irrigation: A broad class of irrigation methods in which water is distributed over the soil surface by gravity flow.

Surface water: An open body of water such as a river, stream, or lake.

Temporary irrigation service land: Irrigable land for which a water supply is delivered under temporary arrangements. The acreage may vary from year to year.

Water application efficiency: Ratio of the average depth of water infiltrated and stored in the root zone to the average depth of water applied.

Water demand: Water requirements for a particular purpose, as for irrigation, power, municipal supply, plant transpiration or storage.

Water rate: The price per acre-foot of water delivered.

Water-rate-only schedule: The farmers pays a certain amount per acre-foot of water delivered. The per acre-foot water rate is constant for all deliveries. Typically, the farmer can receive any desired level of deliveries.

BLANK WORKSHEETS

District Water Deliveries Worksheet

District Water Deliveries Worksheet		
1.	Total Deliveries (acre-feet)	

Line 1. **Total Deliveries.** Enter the total deliveries of water made to district irrigators in an average year (acre-feet).

Alternative Water Supply Worksheet

Alternative Water Supply Worksheet		
Available Annual Alternative Supply		Average Cost ($/acre-foot)
2.	Minimum Cost ($/acre-foot)	

Line 2. Enter the cost of each alternative supply, in dollars per acre-foot, and identify the minimum cost of the available alternative supplies.

Fixed Costs Worksheet

Fixed Costs Worksheet		
3.	Total Repayment Obligation ($/year)	
4.	Administration & Maintenance Costs ($/year)	
5.	Replacement Reserve Fund ($/year)	
6.	Other Fixed Costs ($/year)	
7.	Total District Fixed Costs ($/year)	

Line 3. **Total Repayment Obligation.** Enter the total annual payments for debt service of all types.

Line 4. **Administration & Maintenance Costs**. Enter the sum of all fixed costs arising from the maintenance of the district except for the cost of water supply and debt service.

Line 5. **Replacement Reserve Fund.** If your district has a fund for replacement of facilities, enter the amount of money you put into the fund each year.

Line 6. **Other Fixed Costs.** Enter any other fixed costs that your district may have that weren't listed above.

Line 7. **Total District Fixed Costs**. Sum the fixed costs listed above.

Variable Costs Worksheet

Variable Costs Worksheet		
8.	Total Annual Pumping Cost ($/year)	
9.	Total Annual Water Treatment Cost ($/year)	
10.	Other Variable Costs ($/year)	
11.	Total District Variable Costs ($/year)	

Line 8. **Total Annual Pumping Costs**. Enter any pumping costs incurred by the district that vary with the amount of water delivered.

Line 9. **Total Annual Water Treatment Cost.** Enter any water treatment costs incurred by the district that vary with the amount of water delivered.

Line 10. **Other Variable Costs.** Enter any other variable costs not listed above.

Line 11. **Total District Variable Costs.** Sum all of the variable costs listed above (Line 8. to Line 10.).

Water Pricing Information Worksheet

Water Pricing Information Worksheet		
12.	Fixed Charge on Acreage ($/acre)	
13.	No-charge Water (acre-feet/acre)	
14.	First Block Rate ($/acre-foot)	
15.	Size of First Block (acre-feet/acre)	
16.	Second Block Rate ($/acre-foot)	
17.	Size of Second Block (acre-feet/acre)	

Line 12. **Fixed Charge on Acreage.** Enter any annual charge levied on acres, in $/acre.

Line 13. **No-charge Water.** Enter the amount of water, in af, for which there is no charge above the fixed charges. Districts with fixed rates only should leave this blank.

Line 14. **First Block Rate**. Enter the water rate, in $/af, charged for the first block of water used. Districts with a single water rate should enter the water rate here. Districts with fixed rates only should leave this blank.

Line 15. **Size of First Block.** Amount of water, in af/acre, for which the first block rate is applicable. Districts with fixed rates only should leave this blank.

Line 16. **Second Block Rate**. The water rate, in $/af, charged for the second block used. Districts with fixed rates only should leave this blank.

Line 17. **Size of Second Block.** Amount of water for which the second block rate is applicable. Districts with fixed rates only should leave this blank.

District Revenues Worksheet

District Revenues Worksheet		
18.	Total District Acreage	
19.	Revenue from Fixed Charges ($/year)	
20.	Revenue from Other Sources ($/year)	
21.	Revenue from Water Rates ($/year)	
22.	Total District Revenue ($/year)	

Line 18. **Total District Acreage.** Total all of the acreage that receives water from the District. This total should equal the acreage on which fixed charges are paid.

Line 19. **Revenue from Fixed Charges**. Enter the annual district revenue from fixed charges that show up on the farmer's water bill.

Line 20. **Revenue from Other Sources.** Enter the annual revenue from sources that don't show up on the farmer's water bill. The most common example of this is *ad valorem* taxes. If your district receives revenue from flood control, recreation or other operations or receives direct payments from the government, enter the total of all of those amounts here.

Line 21. **Revenue from Water Rates**. Enter the annual revenue from unit charges applied to water. These charges show up on a farmer's bill as a charge for acre-feet of water delivered, number of irrigations, etc. Use the average revenue for recent years.

Line 22. **Total District Revenue.** Sum all of the forms of annual revenue listed above (Line 19. to Line 21.).

Water Conservation Goal Worksheet

Water Conservation Goal Worksheet		
23.	Desired Water Savings (%)	

Line 23. **Desired Water Savings.** Enter the district's goal for reducing water use as a percentage of current water use. Enter zero if you wish to keep water use the same.

Revenue Goal Worksheet

Revenue Goal Worksheet		
24.	Desired Revenue Increase (%)	

Line 24. **Desired Revenue Increase.** Enter the district's goal for increasing revenue as a percentage of current revenue. Enter zero if you wish to keep revenue the same.

Current District Response Price Worksheet

Current District Response Price Worksheet		
25.	Current Water Rate ($/acre-foot)	
26.	Current Fixed Charge ($/acre)	
27.	Current Total District Revenue ($)	
28.	Current Total Water Deliveries (acre-feet)	
29.	Current District Average Price ($/acre-foot)	
30.	Current District Response Price ($/acre-foot)	

Line 25. **Current Water Rate.** Enter the **First Block Rate** from the *Water Pricing Information Worksheet* (Line 14.).

Line 26. **Current Fixed Charge.** Enter the **Fixed Charge on Acreage** from the *Water Pricing Information Worksheet* (Line 12.).

Line 27. **Current Total District Revenue.** Enter the **Total District Revenue** from the *District Revenues Worksheet* (Line 22.).

Line 28. **Current Total Water Deliveries**. Enter the **Total Deliveries** from the *District Water Deliveries Worksheet* (Line 1.).

Line 29. **Current District Average Price.** Calculate the district-wide average price per acre foot by dividing **Current Total District Revenue** (Line 27.) by **Current Total Water Deliveries** (Line 28.).

Line 30. **Current District Response Price.** Calculate the district-wide response price by adding the district's **Current Water Rate** (Line 25.) to the **Current District Average Price** (Line 29.) and dividing this sum by 2.

New Response Price Worksheet

New Response Price Worksheet		
31.	Conservation Goal (%)	
32.	Desired Change in Water Deliveries (acre-feet)	
33.	Desired Water Deliveries (acre-feet)	
34.	Elasticity	
35.	Required Change in Response Price (%)	
36.	Change in Response Price ($/acre-foot)	
37.	New District Response Price ($/acre-foot)	

Line 31. **Conservation Goal.** Fill in data from **Desired Water Savings**, Line 23. of the *Water Conservation Goal Worksheet*.

Line 32. **Desired Change in Water Deliveries.** Calculate by multiplying **Current Total Water Deliveries** (Line 28.) by **Conservation Goal** (Line 31.).

Line 33. **Desired Water Deliveries.** Calculate by subtracting **Desired Change in Water Deliveries** (Line 32.) from **Current Total Water Deliveries** (Line 28.).

Line 34. **Elasticity.** Enter an elasticity based on the type of water rate structure you currently have (see table below). If your current rate structure is a fixed charge only use 0.10. If your current rate structure is a combination of a fixed charge and a water rate, use 0.15. If your current rate structure has only a water rate, use 0.20.

Type of Rate Schedule	Elasticity
Fixed Charge Only	0.10
Combination	0.15
Water Rates Only	0.20

Line 35. **Required Change in Response Price.** Calculate by dividing **Conservation Goal** (Line 31.) by **Elasticity** (Line 34.).

Line 36. **Change in Response Price.** Calculate by multiplying **Required Change in Response Price** (Line 35.) by your **Current District Response Price** (Line 30.).

Line 37. **New District Response Price.** Calculate by adding the **Change in Response Price** (Line 36.) to the **Current District Response Price** (Line 30.).

New Water Rate Worksheet

New Water Rate Worksheet		
38.	Revenue Goal (%)	
39.	Desired Change in Revenues ($)	
40.	Desired Total District Revenues ($)	
41.	New District Average Price ($/acre-foot)	
42.	New Water Rate ($/acre-foot)	

Line 38. **Revenue Goal.** Fill in data from **Desired Revenue Increase**, Line 24. of the *Revenue Goal Worksheet*.

Line 39. **Desired Change in Revenues.** Obtain by multiplying **Revenue Goal** (Line 38.) by the **Current Total District Revenue** (Line 27.).

Line 40. **Desired Total District Revenues.** Calculate by adding **Desired Change in Revenues** (Line 39.) to the **Current Total District Revenue** (Line 27.).

Line 41. **New District Average Price.** Calculate by dividing **Desired Total District Revenues** (Line 40.) by **Desired Water Deliveries** (Line 33.).

Line 42. **New Water Rate.** Multiply the **New District Response Price** (Line 37.) by 2 then subtract the **New District Average Water Rate** (Line 41.).

New Fixed Charge Worksheet

New Fixed Charge Worksheet		
43.	New Water Rate Revenues ($)	
44.	Fixed Charge Revenue Requirement ($)	
45.	Total District Acreage in Production (acre)	
46.	New Fixed Charge ($/acre)	

Line 43. **New Water Rate Revenues.** Calculate by multiplying the **New Water Rate** (Line 42.) by **Desired Water Deliveries** (Line 33.).

Line 44. **Fixed Charge Revenue Requirement.** Obtain by subtracting **New Water Rate Revenues** (Line 43.) from **Desired Total District Revenues** (Line 40.).

Line 45. **Total District Acreage in Production**. Fill in **Total District Acreage** from Line 18. of the *District Revenues Worksheet*.

Line 46. **New Fixed Charge.** Calculate by dividing the **Fixed Charge Revenue Requirement** (Line 44.) by **Total District Acreage In Production** (Line 45.).

Free Water Worksheet

Free Water Worksheet		
47.	Free Water Allotment (acre-feet/acre)	
48.	Required Increase in Fixed Charge ($/acre)	
49.	Adjusted Fixed charge ($/acre)	

Line 47. **Free Water Allotment**. Enter number of acre-feet of free water you will provide to each acre of land in return for payment of fixed charges.

Line 48. **Required Increase in Fixed Charge**. Multiply the **Free Water Allotment** (Line 47.) by the **New Water Rate** (Line 42.).

Line 49. **Adjusted Fixed Charge**. Add the **Required Increase in Fixed Charge** (Line 48.) to the **New Fixed Charge** (Line 46.).

Elasticity Adjustment Worksheet

Elasticity Adjustment Worksheet		
50.	Anticipated Change in Water Deliveries (acre-feet)	
51.	Anticipated Change in Water Deliveries (%)	
52.	Anticipated Elasticity	

Line 50. **Anticipated Change in Water Deliveries.** Enter the reduction in water use, in acre-feet, that you might anticipate in response to the *change in your rates*.

Line 51. **Anticipated Change in Water Deliveries.** Calculate the anticipated fractional change in water deliveries by dividing the **Anticipated Change in Water Deliveries (**Line 50.) by the **Total Deliveries** from the *District Water Deliveries Worksheet* (Line 1.) The percentage should be greater than the your desired conservation goal.

Line 52. **Anticipated Elasticity.** Calculate the anticipated elasticity value by dividing the **Anticipated Change in Water Deliveries** (Line 51.) by the **Required Change in Response Price** (Line 35.).

Bill Impact Worksheet

Bill Impact Worksheet		
Current Water Bill		
53.	Current Fixed Charge ($/acre)	
54.	Annual Water Use (acre-feet/acre)	
55.	Current Water Rate ($/acre-foot)	
56.	Current Water Rate Bill ($/acre)	
57.	Total Current Bill ($/acre)	
New Water Bill		
58.	New Fixed Charge ($/acre)	
59.	Annual Water Use (acre-feet/acre)	
60.	New Water Rate ($/acre-foot)	
61.	New Water Rate Bill ($/acre)	
62.	Total New Bill ($/acre)	
63.	Difference in Bill ($/acre)	

Line 53. **Current Fixed Charge.** Enter the original fixed charge per acre.

Line 54. **Annual Water Use.** Enter the annual water use per acre for the bill recipient.

Line 55. **Current Water Rate.** Enter the original water rate, in dollars per acre-foot.

Line 56. **Current Water Rate Bill**. Multiply the **Annual Water Use** (Line 54.) times the **Current Water Rate** (Line 55.).

Line 57. **Total Current Bill**. Add the **Current Fixed Charge** (Line 53.) to the **Current Water Rate Bill** (Line 56.)

Line 58. **New Fixed Charge.** Enter the new fixed charge per acre.

Line 59. **Annual Water Use**. Enter the annual water use per acre (to assess immediate bill impact, this water amount should be the same as that used for the current bill).

Line 60. **New Water Rate**. Enter the new water rate, in dollars per acre-foot.

Line 61. **New Water Rate Bill**. Multiply the **Annual Water Use** (Line 59.) times the **New Water Rate (**Line 60.).

Line 62. **Total New Bill**. Add the **New Fixed Charge** (Line 58.) to the **New Water Rate Bill** (Line 61.).

Line 63. **Difference in Bill.** Subtract the **Total New Bill** (Line 62.) from the **Total Current Bill** (Line 57.).

Initial Rate Schedule Worksheet

Initial Rate Schedule Worksheet		
64.	Current Fixed Charge ($/acre)	
65.	Current Water Rate ($/acre-foot)	
66.	Target Water Rate ($/acre-foot)	
67.	Initial Water Rate ($/acre-foot)	

Line 64. **Current Fixed Charge**. Enter the fixed charge in place in the district before conservation pricing, from the **Fixed Charge on Acreage** in the *Water Pricing Information Worksheet* (Line 12.).

Line 65. **Current Water Rate**. Enter the **First Block Rate** from the *Water Pricing Information Worksheet* (Line 14.). Enter zero if you don't have a water rate.

Line 66. **Target Water Rate**. Enter the **New Water Rate** calculated in the *New Water Rate Worksheet* (Line 42.).

Line 67. **Initial Water Rate**. Add the **Current Water Rate** (Line 65.) to the **Target Water Rate** (Line 66.), and divide the sum by 2.

Rate Adjustment Worksheet

Rate Adjustment Worksheet		
68.	Initial Water Rate ($/acre-foot)	
69.	Previous Year Water Deliveries (acre-feet)	
70.	Previous Year Water Rate Revenues ($)	
71.	Total District Acreage in Production (acre)	
72.	Previous Year Fixed Charge ($/acre)	
73.	Previous Year Fixed Charge Revenues ($)	
74.	Previous Year Total Revenues ($)	
75.	Revenue Goal ($)	
76.	Excess Revenues ($)	
77.	Excess Revenues per Acre($/acre)	
78.	Fixed Charge Adjustment ($/acre)	
79.	New Fixed Charge ($/acre)	

Line 68. **Initial Water Rate.** Enter the **Initial Water Rate** calculated in the *Initial Water Rate Worksheet* (Line 67.).

Line 69. **Previous Year Water Deliveries.** Enter the amount of water you actually delivered in the previous year.

Line 70. **Previous Year Water Rate Revenues.** Multiply the **Initial Water Rate** (Line 68.) by the **Previous Year Water Deliveries** (Line 69.).

Line 71. **Total District Acreage in Production.** Enter the **Total District Acreage** from the *District Revenues Worksheet* (Line 18.).

Line 72. **Previous Year Fixed Charge.** Enter the fixed charge in place during the previous year. If this is year two, then this will be the **Fixed Charge on Acreage** from the *Water Pricing Information Worksheet* (Line 12.). Otherwise it will be the **New Fixed Charge** from the *Rate Adjustment Worksheet* (Line 79.) for the previous year.

Line 73. **Previous Year Fixed Charge Revenues.** Multiply the **Total District Acreage in Production** (Line 71.) by the **Previous Year Fixed Charge** (Line 72.).

Line 74. **Previous Year Total Revenues.** Add the **Previous Year Fixed Charge Revenues** (Line 73.) to the **Previous Year Water Rate Revenues** (Line 70.).

Line 75. **Revenue Goal.** Enter the **Desired Total District Revenues** from *New Water Rate Worksheet* (Line 40.).

Line 76. **Excess Revenues.** Subtract the **Revenue Goal** (Line 75.) from the **Previous Year Total Revenues** (Line 74.).

Line 77. **Excess Revenues per Acre.** Divide the **Excess Revenues** (Line 76.) by **Total District Acreage in Production** (Line 71.).

Line 78. **Fixed Charge Adjustment.** Divide the **Excess Revenues per Acre** (Line 77.) by 2.

Line 79. **New Fixed Charge.** Subtract the **Fixed Charge Adjustment** (Line 78.) from the **Previous Year Fixed Charge** (Line 72.).

Water Conservation Response Worksheet

Water Conservation Response Worksheet		
80.	Normal Water Deliveries (acre-feet)	
81.	Actual Water Deliveries (acre-feet)	
82.	Actual Water Conservation Amount (acre-feet)	
83.	Water Conservation Goal (acre-feet)	
84.	Water Delivery Target (acre-feet)	
85.	Difference Between Goal and Actual (acre-feet)	
86.	Percent Difference	

Line 80. **Normal Water Deliveries.** Enter your base year water deliveries, from **Total Deliveries** in the *District Water Deliveries Worksheet* (Line 1.).

Line 81. **Actual Water Deliveries.** Enter the actual water deliveries in the previous year.

Line 82. **Actual Water Conservation Amount.** Subtract **Actual Water Deliveries** (Line 81.) from **Normal Water Deliveries** (Line 80.).

Line 83. **Water Conservation Goal.** Enter your water conservation goal, in acre-feet, from the **Desired Change in Water Deliveries** in the *New Response Price Worksheet* (Line 32.).

Line 84. **Water Delivery Target.** Subtract Water **Conservation Goal** (Line 83.) from **Normal Water Deliveries** (Line 80.).

Line 85. **Difference Between Goal and Actual.** Subtract **Water Conservation Goal** (Line 83.) from **Actual Water Conservation Amount** (Line 82.).

Line 86. **Percent Difference.** How much did you overshoot or undershoot your water conservation goal, as a percentage? Divide **Difference Between Goal and Actual** (Line 85.) by **Water Conservation Goal** (Line 83.) and multiply by 100.

Adjust Fixed Charges Worksheet

Adjust Fixed Charges Worksheet		
87.	Revenue Goal ($)	
88.	Actual Water Deliveries (acre-feet)	
89.	Water Rate ($/acre-foot)	
90.	Water Rate Revenues ($)	
91.	Required Fixed Charge Revenues ($)	
92.	Total District Acreage	
93.	New Fixed Charge ($/acre)	

Line 87. **Revenue Goal.** Enter the **Desired Total District Revenues** from the *New Water Rate Worksheet* (Line 40.).

Line 88. **Actual Water Deliveries.** Enter the **Actual Water Deliveries** from the *Water Conservation Response Worksheet* (Line 81.).

Line 89. **Water Rate.** Enter the **New Water Rate** from the *New Water Rate Worksheet* (Line 42.).

Line 90. **Water Rate Revenues.** Multiply the **Actual Water Deliveries** (Line 88.) by the **Water Rate** (Line 89.).

Line 91. **Required Fixed Charge Revenues.** Subtract the **Water Rate Revenues** (Line 90.) from the **Revenue Goal** (Line 87.).

Line 92. **Total District Acreage.** Enter the **Total District Acreage** from the *District Revenues Worksheet* (Line 18.).

Line 93. **New Fixed Charge.** Divide **Required Fixed Charge Revenues** (Line 91.) by the **Total District Acreage** (Line 92.).

Actual Elasticity Worksheet

Actual Elasticity Worksheet		
94.	Change in Response Price (%)	
95.	Actual Water Conservation Amount (acre-feet)	
96.	Normal Water Deliveries (acre-feet)	
97.	Water Use Change (%)	
98.	Actual Elasticity	

Line 94. **Change in Response Price.** Enter the **Required Change in Response Price** from the *New Response Price Worksheet* (Line 35.).

Line 95. **Actual Water Conservation Amount.** Enter the **Actual Water Conservation Amount** from the *Water Conservation Response Worksheet* (Line 82.).

Line 96. **Normal Water Deliveries.** Enter the **Total Deliveries** from the *District Water Deliveries Worksheet* (Line 1.).

Line 97. **Water Use Change.** Divide **Actual Water Conservation Amount** (Line 95.) by **Normal Water Deliveries** (Line 96.).

Line 98. **Actual Elasticity.** Divide **Water Use Change** (Line 97.) by **Change in Response Price** (Line 94.).

ADVANCED TOPICS

Tiered Pricing

Instead of adjusting the fixed charge to obtain the desired district revenues, the district may wish to implement a tiered price schedule. In a tiered price schedule, the second block price is the new water rate and the first block price is adjusted to achieve the district revenue goal. The baseline assumption is that the first block size is defined small enough that all users will consume in the second block. The first block represents a fixed quantity of water for which revenues can be adjusted directly by the first block price. After calculating the revenue changes that result from the new water rate, the first block revenue is adjusted to meet the desired revenue.

Calculate First Block Price to Meet Revenue Goal		
		District B
1.	New Unadjusted Water Rate Revenue ($)	1,439,820
2.	Desired Revenue Less Unadjusted Water Rate Revenue ($)	387,180
3.	Revenue from Current Fixed Charge ($)	900,000
4.	Required Adjustment to Water Rate Revenue ($)	-512,820
5.	District Acreage	30,000
6.	Required Adjustment to Water Rate Revenue ($/acre)	-17.09
7.	First Block Size (acre-feet/acre)	2
8.	Required Adjustment to Water Rate on First Block ($/acre)	-8.55
9.	First Block Price ($/acre-foot)	4.08
10.	Second Block Price ($/acre-foot)	12.63
11.	Fixed Charge ($/acre)	30.00

Line 1. The **New Unadjusted Water Rate Revenue** is obtained by multiplying desired water deliveries by the new water rate (from the *New Fixed Charge Worksheet*).

Line 2. **Desired Revenue Less Unadjusted Water Rate Revenue** is obtained by subtracting the new unadjusted

water rate revenue from the desired revenue (from the *New Water Rate Worksheet*).

Line 3. **Revenue from Current Fixed Charge** is obtained by multiplying the fixed charge per acre times the number of acres (from the *District Revenues Worksheet*).

Line 4. **Required Adjustment to Water Rate Revenue** is calculated by subtracting Line 3 from Line 2.

Line 5. **District Acreage** is obtained from the *District Revenues Worksheet*.

Line 6. **Required Adjustment to Water Rate Revenue** is calculated by dividing Line 4 by Line 5.

Line 7. The **First Block Size** should be set at a level that all water users would be expected to use.

Line 8. **Required Adjustment to Water Rate on First Block** is obtained by dividing Line 6 by Line 7.

Line 9. **First Block Price** is calculated by subtracting Line 8 from the new water rate (from the *New Water Rate Worksheet*).

Line 10. The **Second Block Price** is the new water rate.

Line 11. The **Fixed Charge** is the original fixed charge from the *Water Pricing Information Worksheet*.