IDAHO DEPARTMENT OF WATER RESOURCES

WATER CONSERVATION MEASURES AND GUIDELINES FOR PREPARING WATER CONSERVATION PLANS

Draft
February 2006

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1.0 INTRODUCTION

On December 11, 2002, the Idaho Department of Water Resources (IDWR) Director designated the Rathdrum Prairie Ground Water Management Area (RPGWMA) to protect the ground water resources and water users of the Rathdrum Prairie-Spokane Valley (RPSV) Aquifer within the state of Idaho. The Director's Order included the development of a Ground Water Management Plan.

On May 4, 2004, the Rathdrum Prairie Ground Water Advisory Committee submitted a Ground Water Management Plan (Plan) to the Director. The Plan identified six goals, including encouraging "water conservation efforts for all users of the resource." A Final Order adopting a ground water management plan was adopted September 15, 2005, by the Department of Water Resources (The Order can be found at: http://www.idwr.idaho.gov/about/orders/Final%20Order%20Rathdrum%20GWMA.pdf). Goal numbers 2 and 5 of the adopted Order established the following conservation requirements:

1. New uses, 0.2 cubic feet per second (cfs) or less, are required to have a functional metering device, the water user must report the total ground water withdrawal once per year, and the water user must agree to a simple list of conservation measures.

2. Existing and new uses, 0.21 cfs to 1.0 cfs, shall have the same requirements as above, plus quarterly monitoring and reporting of ground water depth.

3. Existing and new uses, 1.01 cfs or greater, shall have the same requirements as above, except the metering device and water depth must be measured monthly and reported quarterly. A conservation plan must be developed if application is made to appropriate water or to transfer a water right. Upon approval of the application, the plan must be reviewed by the right holder every five years, at a minimum, to evaluate the effectiveness in achieving the conservation goals.

4. For all new water rights or changes to existing water rights held by municipal purveyors, IDWR will require conservation plans for all systems regulated as public water systems. IDWR will enforce adherence to the conservation plan provisions through water right conditions and civil penalties as allowed by law.

The Order further states that each conservation plan may include the elements as listed in guidelines published by U.S. Environmental Protection Agency (EPA) (EPA. 1998. *Water Conservation Plan Guidelines*. http://www.epa.gov/owm/water-efficiency/webguid.html.)

1.1 Purpose and Organization

This document identifies conservation measures, reporting requirements, and conservation plan requirements for existing and new water users on the RPSV Aquifer.

This document builds upon the EPA's *Water Conservation Plan Guidelines* and incorporates features from other western states' conservation plans. This document is not intended to be all inclusive; rather, it describes the minimum measures that each category of water user can implement or should include in a conservation plan. It does not provide specific one-size-fits-all measures, as water districts and users face unique situations. For example, the document identifies a tiered rate structure to encourage conservation, but does not specify the specific rate to use. Each water district shall identify its own tiered rates using the criteria identified in this document.

This document is organized into two main sections:

- Section 2. Conservation measures and reporting requirements for new uses 0.2 cubic feet per second (cfs) or less; existing and new uses 0.21 to 1.00 cfs; and existing and new uses 1.01 cfs or greater and that are not required to prepare a conservation plan.

- Section 3. Guidance and required elements of a conservation plan for existing and new users of 1.01 cfs or greater if application is made to appropriate water or to transfer a water right.

  Guidance and required elements of a conservation plan for all new water rights or changes to existing water rights held by municipal purveyors.

This document is significantly different from the EPA document in that it does not make a distinction between conservation plan requirements based on the number of people served by a system and/or district. All water districts and consumers are encouraged to consider all conservation measures contained in this document to maximize conservation efforts.

2.0 CONSERVATION MEASURES AND REPORTING REQUIREMENTS FOR WATER USERS NOT REQUIRED TO PREPARE A CONSERVATION PLAN

Conservation measures for new uses of 0.2 cubic feet per second (cfs) or less; existing and new uses of 0.21 to 1.00 cfs; and existing and new uses of 1.01 cfs or greater and that are not required to prepare a conservation plan are specified in Table 2-1; additional information on specific measures is provided in Appendix C. If a district or user implements conservation measures that are not identified in Table 2-1, the annual or quarterly report should provide a brief description of the measure and its expected efficiency. Districts and users are encouraged to select and implement as many measures as possible from Table 2-1. However, if resources are limited, districts and users should select the measures that will provide the greatest amount of conservation, and should select at least one measures from each applicable category. Districts should implement an on-going education program in additional to structural measures.

For existing and new uses of 1.01 cfs or greater that require a conservation plan, the conservation measures contained in Table 2-1 may be part of the conservation plan. However, the conservation plan should follow the format specified in Section 3. Municipal purveyors seeking new water rights or changes to water rights should also follow the format specified in Section 3.

Table 2-1. Water Conservation Measures for New Uses 0.2 Cubic Feet per Second (cfs) or Less; Existing and New Uses 0.21 to 1.00 cfs; and Existing and New Uses 1.01 cfs or Greater.

Fixtures and Appliances
❑ Install low flow or ultra low flow toilets.
❑ Install dual flush toilets.
❑ Install waterless urinals.
❑ Install low flow shower heads and faucets.
❑ Install fingertip faucet valve – this allows the user to temporarily turn off the water (e.g., turn off while brushing teeth and on when rinsing).
❑ Install electronically activated faucets for public areas.
❑ Install high efficiency clothes washer and dishwasher.
❑ Replace leaking bathtub plug or plug washer, tub diverter valve, or toilet flapper valve.
Landscaping – Residential, Golf Course, Cemetery, and Park
❑ Reduce irrigated turf areas.
❑ Replace irrigated turf areas with Xeriscaping and/or native plants. Growing plants that are suited to the area can save more than 50 percent of the water normally used to care for outdoor plants.
❑ Install efficient irrigation equipment, and schedule and use properly.
❑ Install rain and/or soil moisture sensors with the irrigation system.
❑ Adjust the watering times (number of minutes) and the frequency of watering (daily, twice a week, etc.) based on weather conditions and seasonal differences.
❑ Check the system regularly for leaks, broken heads, and other problems.
❑ Adjust the sprinkler heads to avoid watering pavement and other non-landscape areas.
❑ Water areas in the shade about 30 percent less than sunny areas.
❑ Use drip irrigation to water trees and shrubs.
❑ To eliminate runoff, set the irrigation timer to cycle 2-4 start times (no longer than 5 minutes each), 1 to 2 hours apart to allow water to soak into the soil. For example: water 3 times for 5 minutes, instead of 15 minutes all at once.
❑ Develop a separate drip watering schedule for trees, shrubs, and flower beds.
❑ Aerate in the spring and fall to loosen soil and reduce runoff.
❑ Apply mulch around trees, shrubs, and flower beds.
❑ Water landscaping early in the morning or late in the evening and on cooler days, when possible, to reduce evaporation. Allowing the grass to grow slightly taller will reduce water loss by providing more ground shade for the roots and by promoting water retention in the soil.

Behavioral
❑ Use appliances (e.g., dishwasher, washing machine) only when full.
❑ Turn off faucet while brushing teeth or shaving.
❑ Shorten time spent in the shower.
❑ Adjust water levels in the washing machine to match the size of the load.
❑ If washing dishes by hand, do not leave the water running.
❑ Turn off the hose between rinses when washing a car or use a commercial car wash facility.
❑ Sweep sidewalks and driveways instead of hosing them down.
❑ Only fill the bathtub as much as necessary. Bathing babies, small children, and pets requires much less water than an adult.
❑ When using a hose, use a spray nozzle with a cutoff handle so water doesn't flow continuously.
Industrial and Commercial Facilities
❑ Reuse and recycle water used in industrial process.
❑ Analyze waste stream to determine areas of conservation and the possibility of reuse.
❑ Assess feasibility of using reclaimed water if it is available.
❑ Only provide water at restaurants when requested.
❑ Install low flow toilets, faucet aerators, electronically controlled toilets and faucets for public restrooms.
❑ For hotels and motels, encourage water conservation by developing educational materials and providing guests the opportunity to decline daily linen changes.
Distribution System Owners and Operators/Purveyors
❑ Identify and repair leaks.
❑ Reduce pressure.
❑ Conduct a system audit to identify “unaccounted” water (e.g., fire hydrants, line flushing).
❑ Remove vegetation from open canals.
❑ Line or place open canals underground.
❑ Install meters and maintain and calibrate existing meters.
❑ Provide incentives and/or rebates for the replacement of high volume appliances and fixtures with efficient fixtures and appliances.
❑ Use reclaimed water for large landscaped areas such as parks, golf courses, and cemeteries.
❑ Audit large-volume water users and large landscaped areas to identify appropriate conservation measures.
❑ Provide current and past water use information on bills. Send bills more frequently to provide more immediate feed-back on water use.
❑ Develop and conduct educational activities targeting all categories of water users.
❑ Implement tiered rates to encourage water conservation.
❑ Construct and operate water supplier spill and tailwater recovery systems.
❑ Automate canal structures.

❑ Develop a water measurement and water use report to track conservation.
Pools and Spas
❑ Use a pool cover. It will reduce water loss due to normal evaporation.
❑ Repair any swimming pool leaks. An inch-a-day leak in a 15-by-30-foot pool can result in a loss of approximately 102,000 gallons per year.
❑ If heated, reduce the pool and spa water temperature. Warmer water evaporates more quickly.
❑ Shut off fountains and waterfalls. The effect of aeration loses a significant amount of water to evaporation.
❑ Manually clean the filter. You will do a more thorough job and use less water. The average backwash uses between 250 to 1,000 gallons of water -- without completely cleaning your filter.
❑ Maintain proper chemical levels and adequate circulation time. You will avoid the need to drain your pool or use excessive water to correct conditions of neglect.
❑ Turn off the tile-spray device on the automatic pool cleaner.
❑ Reevaluate the frequency of backwashing if the pool has no separation tank. Most people backwash more frequently than necessary. Some pool filters do not require backwashing; they can be taken apart and cleaned.

Report forms for annual and quarterly submittals are included in Appendix A. New water uses of 0.2 cfs or less are required to submit reports annually, and existing and new water uses of 0.21 cfs or greater are required to submit reports quarterly. Annual reports are due on January 31. Quarterly reports are due as follows:

Reporting Period	Due Date
January – March	April 30
April – June	July 31
July – September	October 31
October – December	January 31

All reports should be sent to:

Idaho Department of Water Resources
Northern Regional Office
1910 Northwest Blvd.; Suite 210
Coeur d'Alene, ID 83814-2615

3.0 CONSERVATION PLAN REQUIREMENTS

The following sections describe the elements that should be included in a conservation plan. Each district is expected to address all of the elements; however, the level of detail should reflect the size and complexity of the district. Blank tables and forms have been provided in Appendix B to facilitate development of a conservation plan. Use of the tables and forms is not mandatory; however, all of the information identified in the forms should be included in the conservation plan.

The requirements and organization are based on the EPA's *Water Conservation Plan Guidelines* and have been modified where appropriate. Modifications include the addition of requirements for agricultural/irrigation districts, removal of redundant material, and formatting changes for consistency. A significant variation from the EPA guidance is the use of one set of forms for all water suppliers, regardless of their size. This was done to encourage all water suppliers to consider all possible conservation measures and analyses.

3.1 Develop a Water System Profile

Developing a water system profile can help districts assess their current conditions, and when combined with a demand forecast, identify future needs. The profile should identify and discuss the key characteristics of the system, such as:

- Existing water rights.
- Geographic area(s) served.
- Population and connections served.
- Categories of key water users, existing facilities, and water demand by customer type.
- Potable and non-potable uses.
- Unaccounted-for water use (e.g., leaks, line flushing, seepage, inaccurate meters, theft, etc.).
- Indoor versus outdoor use, seasonality of use, and other temporal variations to the extent appropriate data are available.
- Historical trends in overall water use and use by customer class (this may help with forecasting future demand).
- Identification of the top water purchasers and the amount of the water that they purchased on a total and percentage basis.

The characterization of current water use is critical to developing and selecting appropriate water conservation measures and programs.

The district should provide a brief assessment of the adequacy and reliability of existing water supplies. For example, a water right holder may be entitled to withdraw water at a specified rate, but the lack of storage capacity may limit the actual amount of water withdrawal. The plan should also identify any physical and regulatory restrictions on the capacity of the source and withdrawal rates and/or volumes.

Worksheet B-1 should be completed for each water right application, permit, transfer, or certificate held by a district. Districts should also complete Worksheet B-2 during this step.

The district should provide a description of previous and current water conservation measures. For each conservation measure, identify the time period the measure was implemented, a qualitative and quantitative discussion of its effectiveness, and a

discussion of why the measure was discontinued (if applicable). Do not include future planned conservation measures in this step; they will be addressed in a later step.

3.1.1 Irrigation/Agricultural Districts

Where applicable, irrigation districts should provide the following information in lieu of the municipal information identified in Worksheet B-2.

- Gross acreage of the district.
- Groundwater pumping capacities and pumping data.
- Current irrigated acreage by crop, evapotranspiration (by crop), irrigation method (e.g., sprinkler, flood), and any leaching requirements to maintain salt balance, if applicable.
- Miles of lined and unlined canals, pipelines, and drains comprising the water delivery system.
- Number, location, and capacity of all reservoirs and tailwater/spill recovery systems.
- Schematic or map depicting service area, water delivery system, existing water diversions and wells, and water measurement devices.
- Delivery records and data, including peak period deliveries.
- How water deliveries to customers are currently measured or calculated. Include a description of the frequency and types of measurements (e.g., meters, calibrated weirs, etc.) levels of accuracy, frequency of calibration, and frequency of maintenance.
- Current rate structure (e.g., declining, uniform, or increasing block) and the billing frequency.
- Environmental resources supported by the district's water supplies (e.g., wetland, pond, stream) and the amount of water used by these areas.
- Type of water-related recreational facilities within the district's service area which are supported by the district's water supplies, and the amount of water required to maintain these facilities.

Table 3-1 is a checklist, or series of issues and questions, that can be used to help irrigation districts identify specific areas or opportunities to improve water management. The checklist is organized into issues common to a majority of irrigation districts. Responding to the questions in the checklist can help with the preparation of a water system profile, identify areas where more information is needed, and identify areas suitable for water conservation measures. The questions on the checklist can also be useful in starting discussions at stakeholder meetings.

Table 3-1. Checklist of Typical Issue Areas

Data Adequacy. Without accurate and reliable information about where, when, and how much water is used, it will be difficult for a district to correctly identify issues. • Do you make regular measurements of flows into all laterals? To your turnouts? • Are all measuring devices in good operating condition? Checked regularly? • Are you able to base billing to customers on measurement of water they actually use? • Do you think you could use more or improved water measurement? • Do you have specific ideas about where and how such measurements should be taken?
Supply Adequacy. Adequacy should be addressed at several different levels, including peak-day demand, seasonal demand, by location, and drought years. • Do you have difficulty meeting overall water demands? Peak-day demand? Seasonal demand? • Are there certain areas of the district that are a problem? • Do you have late season shortages? • Have you compared actual diversions and deliveries to estimated crop requirements? • Have you estimated your overall system conveyance losses?
Facility Condition. Operation and maintenance equipment, conveyance and distribution system, and on-farm delivery systems should be considered. • Are frequent equipment breakdowns or lack of proper equipment hampering timely operation and maintenance activities? • Does the district distribution system experience chronic canal breaks or excessive seepage? • Are water control devices in good repair and providing adequate water control? • Are there adequate measuring devices to provide proper control of flows? • Are there specific district facilities that require an unusual amount of maintenance? • Do some farmers waste significant amounts of water because their on-farm delivery systems are old, poorly maintained, or inappropriate for the crop?

Delivery Schedules. When deliveries do not match needs, there is a potential for wasted water and/or unmet orders. Closely matching deliveries to needs can result in significant water savings and may address peak-day shortages.

- Do you run water continuously in canals and laterals?
- Do irrigators in your district have access to monitoring and scheduling services telling them when they need to irrigate?
- Do you use a rigid schedule (rotation) or advanced ordering (demand) system for water deliveries?
- How far in advance do users need to place orders? Can you fill orders on a shorter notice?
- Do you have the ability to quickly check or shut down laterals and canals to avoid spills?

Application Efficiency. Efficient application not only involves delivering the right amount of water to a farm at the right time, but delivering water to the root zone in a uniform manner without over- or under-watering. Field management and characteristics, water application methods, and irrigator skill can all impact efficiency. Inefficient water application can be a significant contributor to wasted water and can impact crop health.

- Are farmers receiving water at the time and in the amount required by the crops? Too often or not enough? Too much or too little?
- Are the farm fields in the district relatively flat or is the land sloping or hilly? Are sprinklers common in the hilly areas?
- Do soil types differ greatly from field to field? Within fields?
- Is there a lot of variability in the effectiveness of on-farm water use?
- Does the district provide demonstration projects or training workshops for irrigators?
- Does the district have programs to make improved water application equipment or technologies more accessible to irrigators?

Drainage and Tailwater Control. Large volumes of drainage and tailwater can be indicative of over-watering.

- Has the district constructed drains to convey tailwater and seepage away from irrigated fields?
- Does the district monitor flows in these drains or at other points to assess the quantities of tailwater and drainage return flows?
- Does the district collect tailwater and drainage flows in ponds? If so, can the water be reused? Pumped back to the district's distribution system?

Water Transfers. Water transfers may be useful in meeting water demands without having to increase production capacity. Water transfers can be formal or informal agreements, permanent or temporary, and within or between districts. Transfers may not result in direct water conservation, but may indirectly conserve water by eliminating or reducing the need for increased withdrawals from the aquifer.

- Is there a method for irrigators to transfer their water shares or allocations to other irrigators?
- Can transfers be made to non-irrigation uses within the district?
- Are there local water needs that could be met by the district if transfers were allowed?
- Are there federal, state, or local laws, regulations, and policies, that would prevent or affect a transfer?

Public Concerns. With changing land uses, pressures for additional water supplies, and increased environmental awareness, a district can expect to face public concerns regarding the use of their water.

- Has the district been approached as a potential source of water? Asked to supply water to an urban development (e.g., residential area, shopping center)?
- Is the district facing changing environmental regulations?
- Is the district's water storage facility also a recreational facility? Subject to relicensing?
- Are there downstream water users who rely on the district's return flows?

(Source: Bureau of Reclamation. September 2000)

3.2 Prepare a Demand Forecast

A demand or water use forecast can be prepared using simple projections based on expected population changes or more complex methods such as modeling. Forecasts can be made for the entire system, but are more accurate when they are prepared for separate water use categories. When preparing a demand forecast, the district should describe the forecasting method that was used (e.g., based on customer categories, land use, season) and why that particular method was selected. The forecast should also take into consideration, where applicable, changing land uses, possible regulatory and legal requirements that will impact water use (e.g., minimum streamflow), alternative sources of water that may become available (e.g., reclaimed water), endangered species issues, and other issues as appropriate. The demand forecast should be prepared for 5, 10, 15, and 20-year increments.

Once the demand forecast has been prepared, it should be adjusted based on currently implemented conservation measures. The adjustment should not include conservation measures that are planned for implementation; these will be considered in another stage of the planning process.

The EPA *Water Conservation Plan Guidelines* caution that using the per-capita and per-connection methods for forecasting have limitations. They assume that water use is a

function of population or changes in the number of connections and that usage patterns will not change with time. Also, a change in a large-volume user in a relatively small district can have significant effects on water use that are not accounted for using per-capita and per-connection estimates.

The demand forecast should also discuss uncertainties in the forecast and how this can affect the projected demand. A "What if" analysis may be useful when preparing a demand forecast. For example, if there are one or two large-volume water users the demand forecast should consider what would happen if the users changed practices or went out of business.

Worksheet B-3 can be used when preparing a demand forecast. Districts should complete a separate worksheet for each category of water users (e.g., residential, municipal, nonaccount water, etc.) and then prepare a worksheet totaling the forecasted demand. This will allow for more accurate forecasting where data are available and may also highlight future uses to target with water conservation efforts.

While Worksheet B-3 can be difficult to complete, completing it as accurately as possible will help focus the conservation efforts and help define conservation goals. Districts should complete as much of Worksheet B-3 as possible with reliable data and not try to fill all fields if data are not available. Documenting data sources, assumptions, and thought processes used when completing Worksheet B-3 is essential. This will allow the district to refine forecasts as more information becomes available.

3.3 Describe Planned Facilities

Districts that anticipate adding or significantly modifying facilities should complete this step. An estimate of the anticipated supply costs based on projected water demand can be used to compare the costs of conservation or demand side measures. Larger districts may find this useful when preparing long-term capital improvement plans, as an evaluation criterion when assessing potential conservation measures, or as justification for future rate hikes. Guidance and worksheets for this step are taken from the EPA *Water Conservation Plan Guidance* without significant modification.

A reasonable accounting of anticipated supply costs is needed in order to compare the cost of supply-side measures to the cost of demand-side or conservation measures (on a cost-per-gallon basis). Districts should choose an appropriate time horizon; a twenty-year or other suitable period can be used. The choice of time frame should be consistent with the demand forecast, as well as the other planning considerations.

Districts should begin by preparing an estimate of major improvements and additions that will be required over the planning horizon in order to meet anticipated demand (including a safe reserve margin). Detailed cost estimates may be available from facility plans or other planning documents. Worksheet B-4 can be used to summarize improvements and additions, which are disaggregated into three categories: source of supply, transmission and treatment, and distribution. (Additional categories can be used as needed.) Districts

should consider all capital facility improvements and additions. Improvements include renovations and expansions needed to maintain or enhance safety or reliability within existing facilities. Additions consist of new facilities. Routine maintenance improvements should not be included. Anticipated water purchases and costs also should be recorded on Worksheet B-4. For this part of the analysis, the effects of conservation measures currently being implemented should be considered, but the effects of new conservation measures on the need for supply capacity or water purchases should be excluded; these effects are addressed in a later step. If no capital improvements and additions are planned, "0" values can be entered and the estimate of supply costs can be based on operating costs (including the cost of energy, chemicals, and purchased water).

Worksheet B-5 provides a method for placing a value on supply-side improvements and additions. Improvements and additions are separated into the following categories: source of supply, water treatment facilities, treated water storage, and major transmission lines. Water purchases are separately recorded. Capital costs over the useful life of the anticipated projects (including financing costs) are annualized and reported on a per-gallon basis. Financing costs can be incorporated into the calculation of *annualized* cost by using the expected interest rate for financing the project(s) or the system's overall cost of capital. Added to the annualized capital cost forecast is the variable operating cost-per-gallon of production for existing and planned facilities, including costs associated with energy, chemicals, and existing and new water purchases. The resulting estimates of total annual incremental costs by type of facility (peak and average) can be used by planners to arrive at a simple estimate of incremental supply costs, which can later be compared to the unit cost of implementing conservation measures.

Supply-side facilities are designed to meet different types of water demand (as summarized in Table 3-2); similarly, different conservation measures affect different types of water demand. Districts should identify, as reasonably possible, the extent to which improvements and additions are needed to meet average and/or peak demand.

Capital-cost reductions associated with conservation will depend on the extent to which supply-side facilities can be eliminated, postponed, or downsized. The effect of conservation on the need for facilities will depend on the demand pattern of the individual utility, as well as its construction cycle (that is, the timing of facilities currently under development). Conservation can be particularly beneficial for systems that have a sufficient planning horizon to integrate conservation with conventional resource options. In some cases, capital costs cannot be avoided but conservation can still yield savings in operating expenditures. A degree of judgment is required in order to evaluate incremental costs and to integrate supply-side and demand-side resources.

This approach produces a very rough estimate of the value of supply-side options. Costs are not escalated to account for the increasing value of water-supply resources over time, discounted to account for the time value of money, or adjusted for inflation.

Table 3-2. Relationship of Water Demand to Supply Facilities

Type of Water Demand	Type of Water Supply Facility
Average-day	Source of supply facilities, including raw water storage facilities (such as reservoirs)
Peak-day	Water treatment plants; major transmission lines
Maximum-hour[a]	Treated water storage facilities; distribution mains[b]; pumping stations[b]

Source: Adapted from Charles W. Howe and F. Pierce Linaweaver, "The Impact of Price on Residential Water Demand and its Relationship to System Design and Price Structure," *Water Resources Research 3* (First Quarter 1967): 13-32.
a. Maximum-day demand plus fire-flow requirements.
b. These facilities should be considered in the analysis if they could be affected by such conservation measures as leak detection and repair, pressure management, or integrated resource management.

Based on the anticipated improvements and additions, districts also can present a preliminary forecast of total supply capacity over the planning period. Worksheet B-6 is provided for this purpose. The forecast, which can be presented in a table or graph, can be used to indicate when changes to capacity are expected to occur. The total supply forecast should reflect both additions to capacity and retirements. Improvements that allow the system to maintain capacity can be indicated with entries under additions to reflect the improvement, and retirements to reflect the facilities taken out of service. A similar analysis can be used for wastewater facilities.

The supply forecast is preliminary because it can and will be revised later in the plan to reflect the effect of planned conservation on water supply needs.

3.4 Develop Conservation Goals

Regardless of the service area or number of customers a district supplies, identifying conservation goals will help develop appropriate conservation measures. General goals can be developed at the start of the planning process and can then be refined as more information about current and future water uses and demands are developed. Specific, measurable goals are need to complete the planning process.

Goals can also be based on the expected gaps in and/or costs of water supply, changing land use and urban growth, or meeting average-day and peak-day demand with existing water rights. Goals should be relevant to the actual issues identified by the district and stakeholders and consistent with information used in developing the water system profile; specific and clearly stated; designed to address short-term and long-term issues and concerns; reflective of the district's mission and goals; and achievement oriented.

The conservation plan should identify:

- Measurable goals (e.g., acre-feet or percentage reduction).

- Area(s) (e.g., per capita water use, industrial water use, peak season demand, high volume users, etc.) that will be managed through water conservation.
- How water savings will be measured.
- Why the goals are appropriate in relationship to system conditions, current and expected water demand, projected new or expanded facilities, additional water rights and/or purchases, and other considerations.
- The process used to develop and refine conservation goals.

3.4.1 Stakeholder Involvement

For conservation plans to be credible and effective, districts need to obtain concurrence and support from all stakeholders; this includes water users, local and community leaders and organizations, federal and state agency staff as applicable, environmental and planning groups, and the district's own governing board. Successful stakeholder involvement will help to:

- Build credibility by establishing an open planning process.
- Identify concerns and values of water users potentially affected by the district's decisions.
- Develop a consensus among diverse user groups.
- Identify conservation measures that are likely to be implemented.

Methods to include stakeholders in the planning process can include questionnaires inserted into bills, public meetings and workshops, and focus and advisory groups.

Stakeholder involvement should not be limited to identification of conservation goals. Rather, stakeholders should be involved through out the planning process. The conservation plan should identify the steps taken to solicit stakeholder input, the number of stakeholder meetings, a summary of stakeholder input, how stakeholder input was incorporated into the plan, and measures for on-going stakeholder involvement.

3.5 Identify Water Conservation Measures

There is a wide range of possible water conservation measures that a district can implement. Conservation measures can be structural (e.g., low flow toilet) or non-structural (e.g., using the dishwasher only when full), and they can include supply-side and demand-side actions. Conservation measures can also vary widely in costs; ranging from relatively simple education material to extensive rebate programs.

Identification of potential conservation measures should initially be done without pre-conceptions about what will, and will not, work. Districts could have a brain storming session that lists all possible conservation measures. Districts could then reduce the list of possible measures for further analysis by applying screening criteria. Development of potential measures is another opportunity to involve stakeholders in the planning process. Stakeholders may not only have ideas that the district has not thought of, they are likely to suggest measures that they are willing to implement.

Worksheet B-7 provides a checklist of possible conservation measures that should be considered by all districts. Districts are expected to implement, at a minimum, basic conservation practices such as metering, water accounting and loss control, costing and pricing, and education programs. If these basic measures are not in place and are not planned for implementation, the district should provide the rationale, including a simple cost-effectiveness analysis, for not implementing these measure. The district should also consider alternative measures that may accomplish the same level of conservation.

Appendix C includes a description of the conservation measures included in Worksheet B-7 and includes additional worksheets that may be useful in assessing proposed conservation measures. Worksheet B-7 also includes comments on the level of detail that a district should provide for specific conservation measures.

Once a district has developed a list of all potential water conservation measures, it will need to screen the list so it can focus on measures that have the highest potential of success. The district should develop screening criteria and document the process used to identify conservation measures carried forward for further analysis. Screening criteria can include legal barriers, cost, public willingness, feasibility, and other factors.

A district may also benefit from evaluating current conservation measures and their effectiveness. Ineffective measures may be dropped or modified and carried forward for further analysis. Determining why current measures are not effective may also help make proposed measures more effective and applicable.

3.5.1 Irrigation/Agricultural Districts

Many of the water conservation activities identified in Table 2-1 and Worksheet B-7 can be implemented by an irrigation/agricultural water district. Additional conservation measures that should be considered include:

- A description of water losses from canals, pipelines, and laterals, including operational spills and measures to reduce these losses.
- Assessment of current irrigation practices and equipment and alternative methods.
- Feasibility of piping or lining earthen canals.
- Modify distribution facilities and schedules to maximize efficiency and encourage conservation.
- Assistance with on-farm irrigation scheduling and audits to identify possible conservation measures.

A district's responses to the questions and issues identified in Table 3-1 can help the district and stakeholders identify water conservation measures based on the major issues and concerns.

3.6 Analyze and Select Conservation Measures

The previous step identified all possible water conservation measures and then reduced the list with screening criteria. In this step, a more detailed analysis is conducted for the remaining conservation measures. For any measures that are found to be infeasible or inappropriate, the district should document the method used to evaluate the measure and why it is infeasible. There are a variety of criteria that can be used to evaluate conservation measures.

The analysis can include, but is not limited to, any of the following considerations:

- Type of customers in the district's service area and the applicability of a conservation measure to those customers.
- Cost of the measure in comparison to costs of other conservation measures, activities, supplier costs (e.g., annual operations, maintenance).
- Effectiveness of a given conservation action to meet the service area needs when compared to other measures, and the overall effectiveness of the measure.
- Impact on revenues. If a district finds that a conservation measure will reduce revenues and cause significant financial problems, this should be explained. However, districts should also look at the conservation measure when combined with a change in rate structure that will replace lost revenue.
- Staff resources, financial resources, and operational constraints.
- Amount of water savings that is expected from a particular measure.
- Community acceptance.
- Environmental impacts.
- Water rights and permit requirements.
- Legal constraints.
- Projected future water use and customer base. A measure that may not be feasible currently may be feasible in the future.
- Combinations of conservation measures.

The conservation plan should identify and document the process that was used to analyze measures, and provide a detailed description of each measure or group of measures (e.g., number of installations, expected lifespan, cost, etc.). The conservation plan should also identify budget and funding mechanisms for conservation measures.

3.6.1 Cost and Benefit Analysis

Worksheet B-8 should be completed for each conservation measure or combination identified by the district. All interrelated measures that are expected to result in an identifiable amount of water savings should be combined and treated as one measure in order to avoid counting the planned water savings more than once in the analysis. Estimates of potential water savings should be as realistic as possible, based on system and regional considerations. For some measures, particularly those dependent on customer responses (such as information and education programs), the estimation will

reflect a high degree of uncertainty. Districts can choose to use a range of estimates under these circumstances.

Worksheet B-8 includes a method for summing the total cost of implementing the measure. All costs associated with implementation should be included. Districts should obtain reasonable cost estimates by potential vendors whenever possible. The types of costs that should be analyzed include materials, labor, rebates or other payments, marketing and advertising, administration, consulting or contracting, and other costs. For each measure, the method used to estimate water savings should be provided. This might include, for example, a formula for converting daily per capita savings to annual savings. In some cases (e.g., such as a leakage control program), it might not be feasible to estimate savings for each unit, in which case total annual savings for the entire measure are sufficient.

The cost of conservation (e.g., $.50 per 1,000 gallons saved) can then be compared to the simple incremental cost of supply (e.g., $2.00 per 1,000 gallons produced). The difference between the per-gallon cost of conservation and the per-gallon cost of supply is a simple indicator of the potential benefits (or cost savings) from conservation.

It is not necessary for districts to prepare a cost-effectiveness or net benefit analysis of conservation measures if those measures are already implemented or planned for implementation. However, an analysis should be presented if cost-effectiveness is the basis for rejecting basic conservation measures (e.g., metering, loss control, costing and pricing, and education). If the analysis of basic measures leads the district to conclude that a proposed measure is not cost-effective or that it fails to meet other criteria for implementation, the plan should include an explanation of these findings and conclusions.

3.6.2 Select Conservation Measures

Once the district has completed the analysis of conservation measures, the district needs to identify the measures that will be implemented. For each measure that is selected, the district should estimate the expected reductions in average-day and peak-day demand. The district should also provide the specific information for each selected conservation measure as indicated in Worksheet B-7.

After selecting conservation measures, the district may want to revisit conservation goals that were identified earlier in the planning process. The district may be able to add or refine quantifiable conservation goals based on expected water savings.

3.7 Integrate Resources and Modify Forecasts

In this step, districts modify their demand forecast based on expected water savings, and identify the effects of conservation on planned supply-side improvements. The EPA *Water Conservation Plan Guidance* identifies the following steps and worksheets to

assist districts with this step. Districts may wish to complete this step as part of their overall planning process and if they described planned facilities in a previous step.

3.7.1 Integrating Options

Districts should be cautious to avoid counting demand-side or supply-side resources more than once in the analysis. Anticipated savings from conservation should be based on realistic estimates of savings associated with the planned measures. Similarly, supply projects that involve multiple facilities should be considered in terms of the total water supply capacity that is made available through those combined facilities. Timing is another issue. The plan should address how different supply-side and demand-side projects involve different life spans and implementation schedules. One twenty-year supply-side project, for example, might be offset by a series of conservation measures that begin and end at different times.

3.7.2 Modifying Demand Forecasts

Districts should use Worksheet B-9 to collate information from previous worksheets and analyses in order to revise the demand forecasts made in Worksheet B-3. Revisions should reflect changes based on the introduction of *new* conservation measures. The effects of measures already being implemented should be included in the original demand forecast.

Modifying the demand forecast requires a considerable degree of judgment, particularly in estimating the effects of conservation on average-day and peak-day demand. The plan should include an explanation of the approach used in revising the demand forecasts.

3.7.3 Project-Specific Savings

Districts should identify the anticipated effects of conservation on planned supply-side improvements and additions (Worksheet B-10). A worksheet should be completed for separable supply projects as appropriate. Ideally, water conservation strategies that reduce demand will translate into supply-side savings through one or more of the following actions:

- Eliminating a project for the foreseeable future.
- Downsizing a project based on reduced capacity needs.
- Postponing a project into the future.
- Eliminating, reducing, or postponing water purchases.

Adjustments to supply-capacity planning must be realistic, especially in terms of complex and sometimes competing goals. Supply projects cannot be eliminated, downsized, or postponed if doing so would compromise public health or safety, reduce operational efficiency, or inflate costs beyond a reasonable amount. Some systems (including systems that currently operate with inadequate or unreliable supply reserves) may not be able to translate all demand reductions into supply-capacity reductions. Planners should

identify and describe such circumstances. On the other hand, supply projects that are not needed or oversized place an unnecessary burden on systems and their customers.

Modifying Supply Forecasts

The supply-capacity forecast from Worksheet B-10 is revised in Worksheet B-11 and should be consistent with accepted supply-capacity planning practices. The modification of forecasts should reflect reasonable assumptions about anticipated implementation schedules. Districts also can indicate the anticipated capacity reserve.

Worksheet B-11 also provides a method of summarizing savings in capital and operating costs, based on reductions in supply capacity. Districts also should estimate reductions in operating costs at existing facilities that will occur with demand reductions (apart from operating costs associated with planned facilities). The total program cost of conservation can be compared with the savings in total capital and annual operating costs.

Revenue Effects

The conservation plan should briefly describe how planned conservation measures will affect water utility revenues and discuss strategies for addressing reduced revenues. Conservation will help the water utility reduce variable costs (e.g., energy, chemical, and purchased water costs). In the long term, conservation also will help the utility reduce fixed costs associated with new capital facilities. In the short term, reductions and sales can lead to a shortfall in revenues needed to cover fixed costs and sustain the financial viability of the water system.

The district can estimate the effect of conservation on revenues by multiplying current water rates by the adjusted level of sales for the variable portion of the water bill. The adjusted level of sales should include the anticipated effects of conservation. Conservation-oriented rate structures have direct revenue effects that should be considered. When rate increases are offset by usage reductions, customer bills and utility revenues can be maintained. Worksheet C-3 in Appendix C can be used to evaluate the revenue effects of rate changes.

3.8 Implementation and Evaluation Strategy

A realistic implementation schedule should also be developed. Any special circumstances affecting the schedule or cost of implementing the proposed measures should be discussed in the plan. For each selected conservation measure, the plan should identify the following:

- Start and end date(s).
- Budget.
- Purchase of required materials (if applicable).
- Contingencies that may affect implementation.
- Necessary permits or approvals as applicable.

- Milestones.
- Evaluation and assessment criteria.

The discussion on evaluation and assessment should identify:

- Data collection for each conservation measure.
- How measures will be assessed in relation to expected water use reductions and conservation goals.
- How forecasted water use will be updated.
- Steps to address underperforming conservation measures.

Districts should also identify how the conservation plan will be reviewed and updated every five years. Additionally, the district should indicate that it has the proper legal authority to implement the selected conservation measures and that its governing body has approved the conservation plan. This is also an opportunity for districts to revise conservation goals. Goals may be changed based on scheduling and/or costs.

4.0 SUMMARY

The reporting forms, worksheets, and planning guidance included in this document provide a framework for individuals and districts to develop sound and effective conservation practices. Conservation measures identified in Table 2-1 and discussed in Appendix C-1 can be used on a district-wide or individual basis. Development of a conservation strategy that is appropriate for the water user(s), identifying current and future water uses, selecting structural and non-structural conservation measures, and evaluating the effectiveness of the measures will contribute to successful water conservation.

Districts should also develop procedures to involve stakeholders in the conservation planning process, develop an education program, and develop an implentation and evaluation strategy. Including these elements will help to ensure that the conservation plan is a "living" plan that will be implemented and change with changing land uses, water uses, and technology.

5.0 REFERENCES

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Appendix A: Annual and Quarterly Report Forms

A-1. ANNUAL GROUND WATER USE AND CONSERVATION REPORT FOR NEW USES 0.2 CUBIC FEET PER SECOND OR LESS

Contact Information		
Name:		
Address:		
City:	State:	Zip Code:
Phone Number:		
Water Right Permit No:		

Meter Information
Meter Location:
Date Meter Installed:
Did the meter function correctly throughout the year? Yes No If no, please describe the malfunction, length of malfunction, and an estimate of ground water withdrawal for the time period.
Was the meter calibrated during the reporting year? Yes No If the meter was not providing correct readings, please provide an estimate of the ground water withdrawal that was not measured by the meter.

Ground Water Withdrawal	
Total Annual Ground Water Withdrawal:	Units:
Reporting Period: _____ to _____ From To	

Conservation Measures		
Please list the specific conservation measures that were implemented throughout the reporting period. Attach additional sheets if necessary.		
Conservation Measure	Implementation Time Period	Will this measure be implemented next year?

Signature
I certify, under penalty of perjury, that the information provided in this report and any attachments are true and accurate to the best of my knowledge. _____ _____ Signature Date

Please submit this form by January 31. If you have more than one meter and/or withdrawal location, please submit a separate report for each meter/location. Completed forms should be sent to:

Idaho Department of Water Resources
Northern Regional Office
1910 Northwest Blvd.; Suite 210
Coeur d'Alene, ID 83814-2615

A-2. ANNUAL GROUND WATER USE AND CONSERVATION REPORT FOR NEW AND EXISTING USES OF 0.21 TO 1.0 CUBIC FEET PER SECOND

Contact Information		
Name:		
Address:		
City:	State:	Zip Code:
Phone Number:		
Water Right Permit No:		

Meter Information
Meter Location:
Date Meter Installed:
Did the meter function correctly throughout the year? Yes No If no, please describe the malfunction, length of malfunction, and an estimate of ground water withdrawal for the time period.
Was the meter calibrated during the reporting year? Yes No If the meter was not providing correct readings, please provide an estimate of the ground water withdrawal that was not measured by the meter.

Ground Water Withdrawal		
Quarter	Ground Water Withdrawal (units)	Depth to Ground Water (units)
January – March		
April – June		
July - September		
October - December		

Conservation Measures		
Please list the specific conservation measures that were implemented throughout the reporting period. Attach additional sheets if necessary.		
Conservation Measure	Implementation Time Period	Will this measure be implemented next year?

Signature
I certify, under penalty of perjury, that the information provided in this report and any attachments are true and accurate to the best of my knowledge. _____ _____ Signature Date

Please submit this form by January 31. If you have more than one meter and/or withdrawal location, please submit a separate report for each meter/location. Completed forms should be sent to:

Idaho Department of Water Resources
Northern Regional Office
1910 Northwest Blvd.; Suite 210
Coeur d'Alene, ID 83814-2615

A.3 QUARTERLY GROUND WATER USE AND CONSERVATION REPORT FOR NEW AND EXISTING USES OF 1.01 CUBIC FEET PER SECOND OR GREATER

Contact Information		
Name:		
Address:		
City:	State:	Zip Code:
Phone Number:		
Water Right Permit No:		

Meter Information
Meter Location:
Date Meter Installed:
Did the meter function correctly throughout the year? Yes No If no, please describe the malfunction, length of malfunction, and an estimate of ground water withdrawal for the time period.
Was the meter calibrated during the reporting year? Yes No If the meter was not providing correct readings, please provide an estimate of the ground water withdrawal that was not measured by the meter.

Ground Water Withdrawal		
Month	Ground Water Withdrawal (units)	Depth to Ground Water (units)

Conservation Measures		
Please list the specific conservation measures selected from your conservation plan that were implemented throughout the reporting period. Attach additional sheets if necessary.		
Conservation Measure	Implementation Time Period	Will this measure be implemented next year?

Signature
I certify, under penalty of perjury, that the information provided in this report and any attachments are true and accurate to the best of my knowledge. _____ _____ Signature Date

Completed forms should be submitted quarterly in accordance with the following schedule:

Reporting Period	Due Date
January – March	April 30
April – June	July 31
July – September	October 31
October – December	January 31

If you have more than one meter and/or withdrawal location, please submit a separate report for each meter/location. Completed forms should be sent to:

Idaho Department of Water Resources
Northern Regional Office
1910 Northwest Blvd.; Suite 210
Coeur d'Alene, ID 83814-2615

Appendix B: Conservation Plan Worksheets

Worksheet B-1: Water Right Information

Water Right Application, Permit, Transfer, or Certificate Number: _____

_____

Priority Date: _____

Source of Water: _____

Beneficial Uses Specified in the Right: _____

_____

Maximum Instantaneous Quantity: _____ Units: _____

Maximum Annual Quantity: _____ Units: _____

Month	Average Monthly Withdrawal			
	Units	Current Year	Previous Year	5 Years Previous
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

Adequacy and Reliability of Existing Water Supplies:

Physical and Regulatory Restrictions:

WORKSHEET B-2: WATER SYSTEM PROFILE

Service Characteristics[1]
Service population (number):
Service area (square miles):
Mains, canals, ditches (linear miles):
Reservoirs (number and volume):
Wells (number):
Separate water systems (number):
Treatment plants (number and capacity):

Annual Water Supply	Annual Volume (units)
Groundwater withdrawal	
Surface water diversions	
Purchases	
Total annual water supply	

Water Demand/Use	Connections (No.)	Annual Volume (units)	Percent Metered
Residential - single-family			
Residential - multi-family			
Commercial			
Industrial			
Irrigation - crop			
Irrigation -pressurized			
Irrigation - golf course, park, cemetery			
Livestock			
Hydropower/Energy Generation			
Aquaculture			
Municipal			
Unaccounted for water			
Total demand			

Average and Peak Demand	Volume	Total Supply Capacity	Percent of Total Capacity
Average-day demand			
Peak-day demand			

Pricing	Rate Structure[2]	Billing Frequency
Residential - single-family		
Residential - multi-family		
Commercial		
Industrial		
Irrigation - crop		
Irrigation - golf course, park, cemetery		
Livestock		
Hydropower		
Aquaculture		
Municipal		

Climate[3]	Average ETo	Average Precipitation (inches)	Average Temperature (°F)
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

Current Water Conservation Activities			
Water Conservation Measure	Annual Water Savings	Implemented Since (date)	Is continued implementation planned?[4]

1. Provide a schematic or map depicting each of the service characteristics.
2. Rate structure can include block, increasing-block, decreasing-block, seasonal, etc.
3. Document source(s) used for climate and evapotranspiration (ETo) data.
4. If a measure is not planned for continued implementation, please provide a brief explanation why.

WORKSHEET B-3: WATER DEMAND FORECAST[1]

Annual Water Demand for _____ (Water Use Category)					
	Current Year	5-Year Forecast	10-Year Forecast	15-Year Forecast	20-Year Forecast
Current annual water demand					
Current population served[2]					
Water demand per capita					
Current acreage served[2]					
Water demand per acre					
Projected population					
Projected change in land use[3]					
Projected annual water demand					
Forecast adjustment[4]					
Adjusted annual water demand					
Current annual water demand					
Current and projected annual water demand					
Current and projected annual supply capacity					
Difference between annual water demand and annual supply capacity					

1. Separate forecasts should be prepared for each user category (e.g., residential, commercial, etc.).
2. Districts may wish to forecast demand based on area rather than population. Current population or area served should be limited to water users within the user category and not all of the district's connections.
3. If the district uses area, estimating demand based on expected changes in land use is more appropriate than population changes. City and county general plans and zoning may be useful in determining changing land uses.
4. Districts may adjust numbers depending on uncertainty in forecasting, implementation of conservation measures, or other factors. Provide a brief explanation of each adjustment, including why the adjustment was used and how it was derived.

AVERAGE-DAY AND PEAK-DAY DEMAND[5]					
	Current Year	5-Year Forecast	10-Year Forecast	15-Year Forecast	20-Year Forecast
1.Current and forecast average-day demand					
2.Current peak-day demand (Worksheet B-2)					
3.Peak-day to average-day ratio (Item 2 divided by Item 1)					
4.Projected peak-day demand (Item 3 multiplied by Item 1)					
5.Adjustment to peak-day demand forecast					
6.Current (Item 2) and adjusted peak-day demand forecast (add Items 4 and 5)					
7.Daily supply capacity					
8.Ratio of peak-day demand to daily supply capacity (Item 6 divided by Item 7)					

5. Depending on the level of detail and water use data collected by a district, it may be more practicable to forecast average-day and peak-day demand using the total water demand instead of by category.

Worksheet B-4: Anticipated Improvements and Additions

Describe planned improvements and additions:

_____

_____

_____

_____

Describe time frame for planned improvements and additions:

_____

_____

_____

_____

Type of Project	Improvement	Addition	Start Date	End Date
Source of supply				
Water treatment facility				
Water storage – treated				
Water storage – untreated				
Transmission lines, canals				
Other: _____				

Project Need (Check all that apply):

_____ Enhance compliance with regulations
_____ Replace older equipment or facilities
_____ Meet average-day demand
_____ Meet peak-day demand
_____ Meet future growth needs
_____ Other: _____

Water Purchases*:*

Anticipated future water purchases/ water right: _____

Cost of future purchase/water right: _____

WORKSHEET B-5: COST OF SUPPLY-SIDE FACILITIES

Line	Item	Average-day Demand Source/Facilities	Peak-day Demand Facilities[1]			Water Purchases to Meet Demand[2]
			Water treatment facilities	Treated water storage	Major transmission lines	
	Supply Capacity (Annual Gallons)[3]					
1	Current capacity or water purchases					
2	Planned improvements and additions					
3	Planned retirements					
4	Future installed capacity or purchases (Add lines 1 and 2 and subtract line 3)					
	Planned Improvements and Facilities (Costs)					
5	Approx. costs of improvements from line 2					
6	Life of new facilities (years)					
7	Annual capital costs (Line 5 divided by line 6)					
8	Annual operating costs[4]					
9	Total annual costs (Add lines 7 and 8)[5]					
10	Per unit cost of new facilities (line 9 divided by line 2)					
	Simple Incremental Supply Costs (Add all entries for line 10): $_____					

1. Additional facilities or capital equipment can be included as appropriate.
2. The plan should indicate whether purchases are needed to meet average-day or peak-day demand or both.
3. Districts should select a reasonable planning horizon for supply facilities and use the same time frame for all facilities.
4. Annual variable operating cost (including energy, chemicals, and water purchases).
5. This calculation of simplified value does not include a discount rate, an escalation rate, or an adjustment for inflation.

WORKSHEET B-6: PRELIMINARY SUPPLY-CAPACITY FORECAST

Year	Additions	Retirements	Total supply capacity for the system (annual or daily)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Worksheet B-7: Checklist of Conservation Measures

Measure	Currently Implemented? Yes or No	Planned Implementation		Information to Include in Conservation Plan
		Fiscal Year	Budget	
Universal Metering				
Source-water metering				Identify number of current meters and number of meters to be installed. If meters will be installed in phases, identify dates, number of meters, and any prioritization used. Worksheet C-1
Service-connection metering				
Meter public use water				
Fixed-interval meter reading				
Meter-accuracy analysis				
Test, calibrate, repair, and replace meters				
WATER ACCOUNTING AND LOSS CONTROL				
Account for water				Identify where all water is used. Worksheets C-2 and C-3.
Repair known leaks				Include description of how leaks will be identified and prioritized for repair.
Analysis of unaccounted water				Include description of how analysis will be conducted and follow-up measures/procedures.
Water system audit				Identify specific facilities owned by the district and when audits will be conducted.
Leak detection and repair strategy				Describe comprehensive strategy including frequency of testing and inspections, methodology, and follow-up activities.
Automated sensors/telemetry				Identify where these may be used, systems that are available, specific installation dates and locations, and expected results.
Loss-prevention program				Identify maintenance activities to prevent leaks or breaks in the delivery system.

Measure	Currently Implemented Yes or No	Planned Implementation		Information to Include in Conservation Plan
		Fiscal Year	Budget	
COSTING AND PRICING				
Cost-of-service accounting				Describe the current rate structure including how the rates were established and how the rates have affected water conservation. Describe proposed changes to the rate structure, steps necessary for implementation, and expected implementation date.
User charges				
Metered rates				
Cost analysis				
No promotional rates				
Tiered rate structure				
Information and Education				
Understandable and informative water bill				Describe the current billing frequency and information on the bill and how these will be modified to encourage conservation.
Conservation information available				Describe what information is available to the public and how the public may access the information (e.g., internet, billboard).
Water-bill inserts				Describe frequency and content for each of the items.
School program				
Public-education program				
Workshops				
Advisory committee				Describe how members will be selected and role of the committee.
Water-use Audits				
Audits of large-volume users				Identify specific user(s), when audit will be conducted, and follow-up activities.
Large-landscape audits				
Selective end-use audits				
Retrofits				
Retrofit program				Identify appliance, water savings, number of retrofits available, distribution, and start date.

Measure	Currently Implemented Yes or No	Planned Implementation		Information to Include in Conservation Plan
		Fiscal Year	Budget	
Pressure Management				
System wide pressure regulation				Identify areas with high pressure, feasibility of reducing pressure without affecting service, and methods and schedule for pressure reduction.
Selective use of pressure-reducing valves				
Landscape Efficiency				
Promotion of landscape efficiency				Describe steps the district will take to reduce outdoor landscape irrigation. Include milestones and start and stop dates.
Landscape planning and renovation				
Selective irrigation submetering				Identify possible locations and schedule for meter installation.
Irrigation management				Identify program to conserve irrigation water.
REPLACEMENTS AND PROMOTIONS				
Rebates and incentives – residential				Identify specific rebates and amounts, total budget, targeted appliances, and expected water savings.
Rebates and incentives – nonresidential				
Promotion of new technologies				Identify specific technology, expected water savings, and how technology will be promoted.
REUSE AND RECYCLING				
Industrial and commercial applications				Identify specific water users, potential for recycling of process water, and reuse and recycling feasibility.
Large-volume water users				
WATER USE REGULATION				
Water-use standards and regulations				Provide the specific requirements, expected water savings, implementation process, expected date of implementation, and enforcement process.
Requirements for new developments				

Worksheet B-8: Cost Analysis of Conservation Measure or Group of Measures

Conservation measure: _____

_____

Typical water savings from the measure: _____ per _____

Number of planned installations/population served: _____

Anticipated life span (years): _____

Designed to reduce: _____ Average-day demand _____ Peak-day demand ____ Both

Line	Item	Amount	Amount
	Conservation Measure Costs	Per Unit	Total Cost
1	Materials		
2	Labor		
3	Rebates or other payments		
4	Marketing and advertising		
5	Administration		
6	Consulting or contracting		
7	Other		
8	Total Program Costs		
	Estimated Savings		
9	Number of units to be installed/population served by implemented measure		
10	Estimated annual water savings (gallons)		
11	Expected life span of the measure (years)		
12	Total life span estimated water savings (gallons)		
	Analysis of Cost Effectiveness		
13	Cost of water saved by the measure (line 8 divided by line 12)		
14	Incremental cost of water supply (Worksheet B-5, line 11)		
15	Cost comparison (line 15 minus line 14)		
	Net Benefit of Conservation		
16	Estimated value of water saved by the measure (line 12 time line 14)		
17	Net value of water saved by measure (line 16 minus line 8)		

Appendix C: Water Conservation Measures

APPENDIX C: WATER CONSERVATION MEASURES

A wide range of water conservation measures was identified in Table 2-1 and Worksheet B-7. This appendix provides a more detailed discussion of those measures and is adapted from the EPA's *Water Conservation Plan Guidelines* (U.S. EPA. 1998).

Individuals should implement as many measures identified in Table 2-1 as feasible and should include structural and nonstructural measures. When preparing conservation plans, districts should consider each of the measures specified in Table 2-1 and Worksheet B-7. Districts may choose to implement measures that are not identified in this document. If a district implements a measure not identified in this document, the district should provide documentation to demonstrate that the measure will result in significant water savings.

A significant difference between this document and EPA's *Water Conservation Plan Guidelines* is the absence of Levels based on the number of customers a district serves. The selection of feasible and appropriate conservation measures can vary greatly with the size of the district as well as with the capabilities of the district and its users. Levels were removed to encourage districts to consider and evaluate all possible conservation measures, to select measures appropriate to their district, and not to confine their analyses to a subset of possible measures.

C.1 Universal Metering.

Metering is a fundamental tool of water system management and conservation. Types of metering include:

- Source-water metering
- Service-connection metering
- Public-use water metering

Service connection metering is necessary to inform customers about how much water they are using; suppliers can use metering data to more accurately track water usage and bill customers for their usage. Public-use water metering measures water provided free of charge for public use. This will allow the district to more accurately account for water. Lack of metering undermines loss control, costing and pricing, and other conservation measures.

A program of fixed-interval meter reading is essential to determine the amount of nonrevenue-producing water. Source meters and service connection meters should be read at the same relative time in order to facilitate accurate comparisons and analysis. Readings generally should occur at regular intervals, preferably monthly or bimonthly. Estimated bills should be kept at a minimum, subject to state and local regulations.

Water meters can be damaged and deteriorate with age, thus producing inaccurate readings. Inaccurate readings will give misleading information regarding water usage,

make leak detection difficult, and result in lost revenue for the system. All meters, especially older meters, should be tested for accuracy on a regular basis. The district also should determine that meters are appropriately sized. Meters that are too large for a customer's level of use will tend to under-register water use.

After determining the accuracy of the metering system, the district should provide a schedule of activities necessary to correct meter deficiencies. Meters should be recalibrated on a regular basis to ensure accurate water accounting and billing. The conservation plan should identify the district's plan for maintaining and calibrating meters.

For districts that are already fully metered, the conservation plan should indicate that all sources of supply and customers are metered. For districts that are not fully metered, the district should consider the following when developing a metering plan (Economic and Engineering Services, Inc., 2003):

- Available metering technologies;
- Appropriate meter size to optimize accuracy including variable flow rates;
- Operational aspects of metering including any necessary changes to billing practices;
- Capital costs of meters and any upgrades needed for the billing system;
- Operational costs of reading meters and entering data including impacts on the billing system; and
- Issues and timing considerations involved in changing from an unmeterd system to a metered system.

Worksheet C-1 can be used by districts to assess their metering practices.

C.2 Water Accounting and Loss Control

In many respects, water conservation begins on the supply side. All water systems will benefit from a water accounting system that helps track water throughout the system and identify areas that may need attention, particularly large volumes of nonaccount water. This measure is particularly effective at addressing average-day demand. Nonaccount water includes water that is metered but not billed, as well as all unmetered water. Unmetered water may be authorized for operation and maintenance and for certain public uses such as fire hydrant maintenance. Unmetered water also includes unauthorized uses, including losses from accounting errors, malfunctioning distribution system controls, thefts, inaccurate meters, or leaks. Some unauthorized uses may be identifiable. When they are not, these unauthorized uses constitute unaccounted-for water.

Implementing a system of water accounting is a necessary first step in developing strategies for loss control. This system for tracking water begins with total water produced and ends with unaccounted-for water. Worksheet C-2 can assist districts in developing a water accounting and loss control strategy.

Account for water. All water systems, even smaller systems, should implement a basic system of water accounting that addresses transmission line losses, reducing unmetered water use, identifying and reducing leaks, and reducing unaccounted water. This accounting exercise provides a basis for a strategy to control losses over time.

Repair known leaks. The cost of water leakage can be measured in terms of the operating costs associated with water supply, treatment, and delivery; water lost produces no revenues for the utility. Repairing larger leaks can be costly, but it also can produce substantial savings in water and expenditures over the long run. Water accounting is less accurate and useful when a system lacks source and connection metering. Although the district should plan to meter sources, unmetered source water can be estimated by multiplying the pumping rate by the time of operation based on electric meter readings.

Analysis of nonaccount water. Nonaccount water use should be analyzed to identify potential revenue-producing opportunities, as well as recoverable losses and leaks. Some utilities might consider charging for water previously given away for public use or stepping up efforts to reduce illegal connections and other forms of theft.

System audit. A system audit can provide information needed to make a more accurate analysis of nonaccount water.

Leak detection and repair strategy**.** Districts also should institute a comprehensive leak detection and repair strategy. This strategy may include regular on-site testing using computer-assisted leak detection equipment, a sonic leak-detection survey, or another acceptable method for detecting leaks along water distribution mains, valves, services, and meters. Divers can be used to inspect and clean storage tank interiors.

Automated sensors/telemetry. Districts should also consider using remote sensor and telemetry technologies for ongoing monitoring and analysis of source, transmission, and distribution facilities. Remote sensors and monitoring software can alert operators to leaks, fluctuations in pressure, problems with equipment integrity, and other concerns.

Loss-prevention program. This may include pipe inspection, cleaning, lining, and other maintenance efforts to improve the distribution system and prevent leaks and ruptures from occurring. Districts might also consider methods for minimizing water used in routine water system maintenance procedures in accordance with other applicable standards.

C.3 Costing and Pricing

The price of water is important because it generates the necessary revenue for a district and can be used to encourage water conservation. Prices, such as a flat rate, that do not correlate to water use can lead to excessive water use. When evaluating current pricing and pricing strategies to promote conservation, districts should consider:

- If current rates promote water conservation.

- Different rate structures (e.g., flat, uniform, declining block, or inverted block), number of tiers, and rates within each tier.
- Patterns of usage (e.g., seasonal water uses).

Under a flat rate structure, a water user pays the same rate regardless of the amount of water conserved. This rate structure is the least likely to encourage water conservation. A uniform rate structure charges the same price per a given unit of water regardless of the amount of water used. Unlike the flat rate, the price for total water used will increase under a uniform rate. Flat and uniform rates are easy to bill as they are straightforward approaches. More complex billing methods include declining and inverted block rates. With either of these approaches, a district defines the number of blocks or steps (e.g., 4 blocks), the size of the blocks (e.g., gallons per day), and the rate for water usage within each block.

The declining block rate charges a lower per unit fee as water consumption increases. While this may seem counterintuitive for water conservation, the structure can result in conservation. Remember that the rate is per unit and is not a flat rate; high volume water users will pay more because of the amount of water they use. This rate does recognize an economy of scale for large-volume water users.

An inverted block rate charges a higher rate for a given unit of water as consumption increases. This may be the most effective rate structure to encourage water conservation. However, districts should evaluate the ability of its customers to pay higher rates in relationship to personnel income. An inverted rate structure that is appropriate for one area may charge too little or too much for another area depending on customers financial situations. Districts should also periodically evaluate if their rate structure is encouraging conservation as customers may become acclimated to higher rates and increase their water use through time.

An example of an inverted block rate for a typical ¾-inch residential home service, adopted by the City of North Las Vegas, is shown in Figure C-1 (Southern Nevada Water Authority).

Districts can also consider a combination of rate structures. Districts may want to evaluate a flat rate regardless of the amount of water used and then a block rate for water used over a given amount. Districts may also consider implementing seasonal water rates or other rate structures that address large-volume water users and/or periods of time.

Worksheet C-3 can also help districts assess the effect of introducing a new rate structure on revenues. Conservation-oriented pricing requires districts to make certain assumptions (based on the available empirical evidence) about the elasticity of water demand, or the responsiveness of water usage to a change in price. Elasticity is measured by the ratio of a percentage change in quantity demanded to a percentage change in price. Changes in the rate structure should allow the system to achieve demand reduction goals

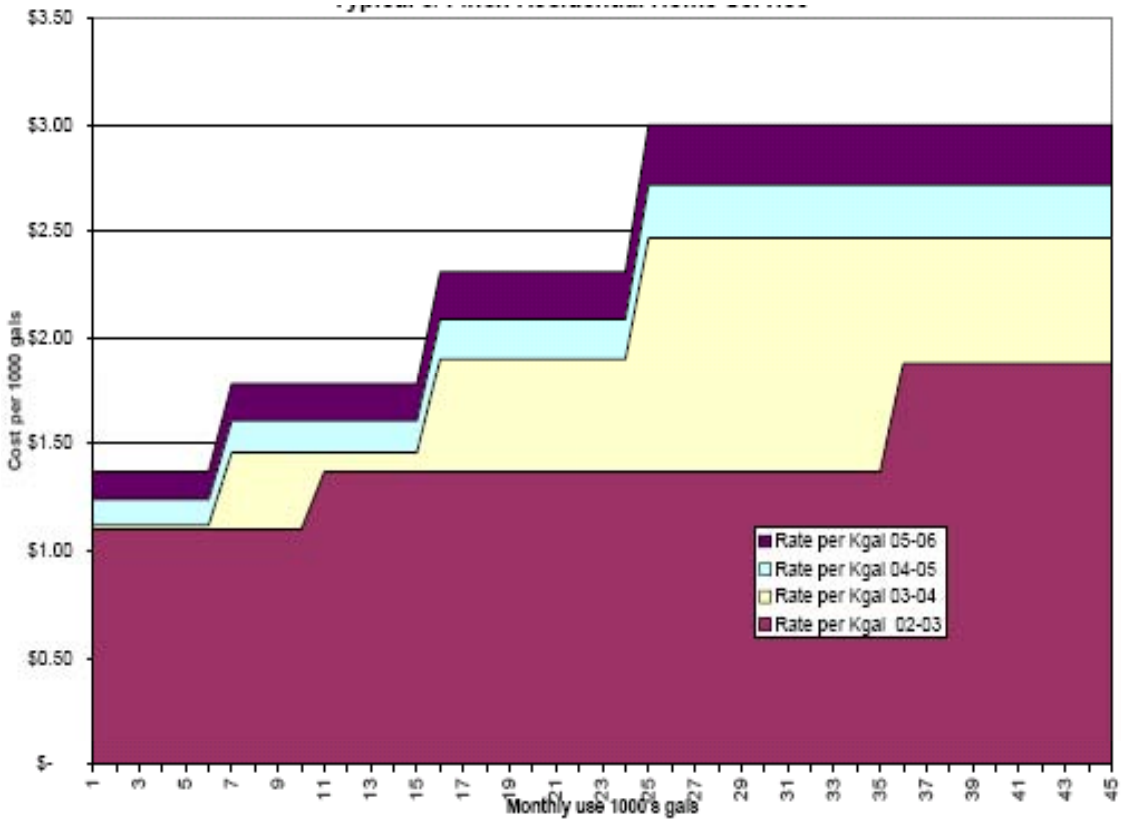


Figure C-1. Example of an inverted block rate.

while recovering water system costs. In allocating costs, the impact of the rate structure on user demand and revenues for specific customer categories should be considered.

C.4 Information and Education

Information and education are critical to the success of any conservation program and can be effective in addressing average-day and peak-day demand, but these savings can be difficult to estimate. Also, public education alone will not produce the same amount of sustained water savings as other, more direct approaches such as leak repairs and retrofits.

Educational measures are more effective when used with other conservation measures. Customers that are informed and involved are more likely to support the district's conservation planning goals.

Education programs can be implemented by districts of all sizes, can target all categories of water users, and can be effective when financial resources are limited. Education programs can include the distribution of simple brochures that provide water saving tips, target seasonal uses (e.g., landscape watering in the summer), be sent in bills, and be made available at public places (e.g., library, water district office). When developing the education component of a conservation plan, districts should consider including one or more of the following:

- Development of portable or fixed displays to use at community events, libraries, schools, and other public buildings.
- Development of standardized materials in partnership with private businesses such as hotels, restaurants, landscaping, home improvement stores, and nurseries.
- Establishment of a "speakers bureau" providing speakers for public events.
- Use of newsletters, brochures, water bill inserts, or press releases to publicize conservation measures.
- Understandable and informative bills that provide volume used, comparison to previous water use, and conservation tips.
- Distribution of devices that have public awareness value in addition to a direct benefit (e.g., rain gauges, faucet aerators).
- Advertising campaign.
- Host workshops for industries that might be able to contribute to water conservation efforts.
- Form and support advisory committees.

Regardless of what education measure(s) a district implements, the measures will have limited effectiveness without ongoing reminders and assessment of their effectiveness. The education program cannot be a once-a-year program. Furthermore, the district should develop simple surveys and methods to compare monthly water use to determine if the education component is resulting in water conservation. The program also needs to be able to respond to changes in water use and customers.

Development of a successful education program provides an excellent opportunity to increase public participation in the conservation planning process. Members of the public can help brainstorm education measures, participate in the speakers bureau, and complete surveys on the effectiveness of conservation measures.

The conservation plan should identify the districts existing and proposed education measures, and indicate why this program is appropriate given their customer base and water use data.

C.5 Water-Use Audits

Water-use or end-use audits can provide districts and their customers with valuable information about how water is used and how usage might be reduced through specific conservation strategies. Audits can be effective in reducing average-day and peak-day demands; provide a quantitative estimate of water loss from leaks; and identify meter inaccuracy, authorized uses that are not currently metered or billed, and unauthorized uses. Audits can focus on large-volume water users and selected end-users. All audits should identify types or categories of water users for each audited facility, areas where water use can be reduced, and methods for reduction (e.g., changing processes, new technology).

An audit program can be selective in terms of targeting customer groups that have particular needs or for which water conservation could be particularly beneficial. Audits targeted to older housing, for example, can be particularly beneficial in terms of identifying and fixing plumbing leaks.

End-use audits also can be tailored to the usage practices within user groups. For example, residential water audits may focus on plumbing fixtures, lawn and garden water practices, and customer behavior. Residential water audits can be used to make immediate repairs and retrofits. Worksheet C-4 summarizes the components of a residential water audit. All water audits should include a written report to the customer that includes specific ideas for conservation. Water audits can be planned and implemented in conjunction with electric power companies or others interested in promoting conservation practices.

C.6 Retrofits, Replacements, and Promotions

Districts can promote conservation through a retrofit program. Retrofitting involves making an improvement to an existing fixture or appliance (versus replacement) in order to increase water-use efficiency. Retrofit programs usually target plumbing fixtures and are typically effective at addressing average-day demand.

Retrofit kits. A basic retrofit kit may include low-flow faucet aerators, low-flow showerheads, leak detection tablets, and replacement flapper valves. Retrofit kits may be made available free or at cost, and can be distributed as part of an audit, in conjunction with public meetings, or by community organizations..

Three studies recently conducted for the Tampa Water Department (Tampa) (Mayer et.al., 2004), East Bay Municipal Utility District (EBMUD) (Mayer et.al., 2003), Seattle Public Utilities (Seattle) (Mayer et. al., 2000) characterized indoor residential water use before and after the installation of water conservation devices. The studies demonstrate that residential indoor water use is similar regardless of the geographic location and that simple water conservation measures can result in substantial water savings. Baseline water use, water use following the installation of water conserving appliances, and water savings are presented in Tables C-1 through C-3. Homes that participated in the studies were retrofitted with high efficiency toilets, clothes washers, showerheads, and faucets.

Table C-1. Indoor Per Capita Residential Water Use (gallons per capita per day)

	Tampa	EBMUD	Seattle	Average
Bath	2.6	3	3.7	3.1
Clothes Washer	14.7	13.9	14.8	14.5
Dishwasher	0.6	1	1.4	1
Faucet	9.4	10.5	9.2	9.7
Leak	18.9	25.7	6.5	17
Shower	12.7	12	9	11.2
Toilet	18	19.9	18.8	18.9

Total	76.9	86	63.4	

Table 2. Indoor Per Capita Residential Water Use Following Installation of Water Saving Features (gallons per capita per day)

	Tampa	EBMUD	Seattle
Bath	2.4	2.8	2.7
Clothes Washer	7.8	8.8	9.2
Dishwasher	0.5	0.9	1.2
Faucet	6.2	10.5	8
Leak	3.7	8.9	2.2
Shower	9.1	10.7	8.7
Toilet	7.8	9.8	7.9

Table 3. Indoor Per Capita Residential Water Savings Following Installation of Water Saving Features (gallons per capita per day)

	Tampa	EBMUD	Seattle
Bath	0.2	0.2	1
Clothes Washer	6.9	5.1	5.6
Dishwasher	0.1	0.1	0.2
Faucet	3.2	0	1.2
Leak	15.2	16.8	4.3
Shower	3.6	1.3	0.3
Toilet	10.2	10.1	10.9

In the Tampa study more than 32 gallons (or 83 percent) of the 38.4 gcd average saved through the retrofit was the result of three usage categories: toilets, clothes washers, and leaks.

The Tampa study found that 10 houses (38 percent) were responsible for more than 85 percent of the total per capita leakage during the baseline period and four houses (15 percent) were responsible for 62.9 percent of the leakage. The top two leaking homes by themselves were responsible for nearly 38 percent of the total leakage. These homes each leaked approximately 90 gcd. This result is similar to the findings from other study sites – a small number of houses are responsible for most of the leakage. The study found that even a low flow leak, such as a leaking toilet flapper, can result in water losses of 0.04 to 0.39 gallons per minute, or approximately 127 gallons per day.

Simple measures, such as repairing leaks and replacing high flow toilets with low flow or dual flow toilets can result in substantial water savings. Also, changes in behavior, such as taking shorter showers can result in significant water savings over time.

In order to accelerate the replacements of older fixtures, districts can offer rebates and other incentives. Districts can install water-efficient fixtures by providing fixtures at no cost, giving a rebate for consumer purchased fixtures, or arranging suppliers to provide

fixtures at a reduced price. Incentive rebate programs can be designed to target all categories of water users.

Districts can also get involved with promoting new technologies by manufacturers and distributors of fixtures and appliances. Demonstrations and pilot programs, and even contests, can be used to introduce and promote new products (such as high-efficiency washing machines).

C.7 Pressure Management

Reducing excessive pressures in the distribution system can save a significant quantity of water and can reduce average-day demand. Reducing water pressure can decrease leakage, amount of flow through open faucets, and stresses on pipes and joints which may result in leaks. Lower water pressure may also decrease system deterioration, reducing the need for repairs and extending the life of existing facilities. Furthermore, lower pressures can help reduce wear on end-use fixtures and appliances.

Systemwide pressure management. For residential areas, pressures exceeding 80 psi should be assessed for reduction. Pressure management and reduction strategies must be consistent with state and local regulations and standards, as well as take into account system conditions and needs. Obviously, reductions in pressure should not compromise the integrity of the water system or service quality for customers.

Pressure-reducing valves. A more aggressive plan may include the purchase and installation of pressure-reducing valves in street mains, as well as individual buildings. Districts might also insert flow restrictors on services at the meter. Restrictors can be sized to allow for service length, system pressure, and site elevation. Districts can consider providing technical assistance to customers to address their pressure problems and install pressure-reducing valves to lower the customers' water pressure. This may be especially beneficial for large-use customers.

C.8 Landscape Efficiency

Outdoor water usage typically drives peak-day demand, which in turn drives requirements for transmission and treatment facilities. Reducing outdoor usage can be a very effective conservation strategy. Outdoor water use can be reduced through efficiency-oriented landscaping principles, such as Xeriscaping™ which includes:

- Planning and design
- Limited turf areas
- Efficient irrigation.
- Soil improvement
- Mulching
- Use of lower water demand plants
- Appropriate maintenance

Districts should assess programs that would retrofit or replace existing high volume sprinkler systems with more efficient irrigation systems such as surface and sub-surface drip irrigation, micro-spray systems, bubblers, and soaker houses are typically more efficient than sprinkler systems. Districts should also assess requiring more efficient irrigation systems in new developments. Even with the most efficient irrigation systems in place, water conservation is not guaranteed. Districts should also include the following measures in a conservation plan that includes water efficient irrigation.

- Proper irrigation zoning to match the different water needs of different types of landscaping.
- Development of irrigation schedules based on evapotranspiration, which refers to water requirements of plants and soils and varies by plant, time of year, and weather.
- Use of rain controllers and/or soil moisture sensors in conjunction with automatic irrigation controllers.

Districts may also want to evaluate the feasibility of restricting turf areas for new developments and reducing the amount of turf area in existing developments. The Southern Nevada Water Authority has successfully implemented a turf reduction program.

Southern Nevada Water Authority — Water Smart Landscape Rebate Program

The Southern Nevada Water Authority (SNWA) implemented a Water Smart Landscapes Rebate program following a five-year study that documented substantial water use reductions by converting turf grass to xeric and/or drought-tolerant plant material. The study found that residents in Southern Nevada annually applied an average of 73 gallons of water per square foot to turf, but just 17.2 gallons annually per square foot after converting turf areas to "water smart" landscape plantings. Based upon the 55.8 gallons per square foot per year water savings, the Water Authority implemented a landscape conversion incentive program. In January 2003, concurrent with adoption of the SNWA drought plan, the Water Authority increased the incentive rate from $0.40 per square foot to $1.00 per square foot. The Water Authority further modified the program to increase appeal by offering a cash incentive rather than a credit to the client's water bill. As a result, participation soared, with as many as 3,000 applicants in a single month. Since program inception, over 64 million square-feet of turf have been replaced, resulting in an estimated savings of 3.5 billion gallons of water annually.

Additional information on this program and other conservation measures implemented by the Southern Nevada Water Authority can be found at: **http://www.snwa.com**

C.9 On-farm Water Use and Irrigation Districts

Improvements in on-farm water use may result in significant water savings; therefore, developing and implementing programs that will maximize farmer participation is critical. On-farm measures can include ditch lining, development of water reuse systems,

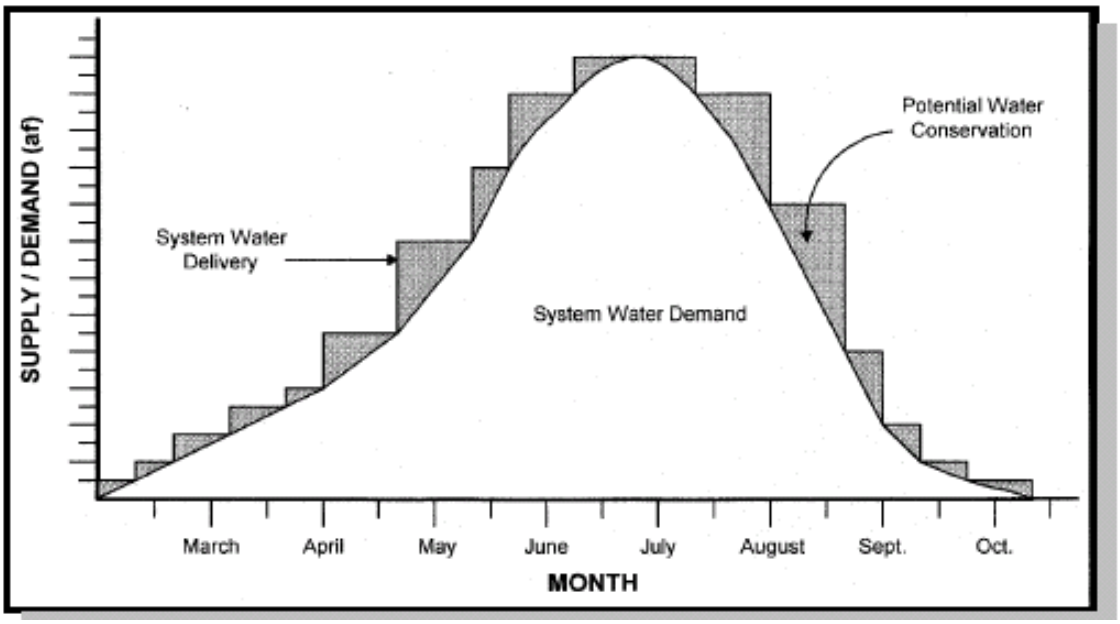
installation of surge valves and gated pipes, sprinkler systems, field leveling, and soil treatments. Additionally, on-farm measures can include irrigation scheduling that is based on crop needs, soil moisture and conditions, and evapotranspiration. Districts can develop education and demonstration programs and provide financial incentives to farmers to implement on-farm measures. Financial incentives can include in-kind services, low interest equipment loans and leases, subsidies, and water rate discounts or rebates for conservation.

Improvements in a district's operating procedures, distribution control, and scheduling can also result in water savings. Changes in operating procedures can include changing ordering and delivery methods. Order and delivery methods vary depending on the water supply, diversion and conveyance facilities, and demands. When evaluating operational changes to conserve water, districts should consider:

- Impacts to water users.
- Efficiency of fixed amount and fixed delivery frequency versus on-demand delivery.
- Canal and lateral operation.
- Reservoir operation.
- Integrating operations with other districts.

Districts may also want to evaluate the physical features of their system (e.g., gates, weirs, canals) for water loss and repair and replacement as necessary. Losses due to seepage from unlined canals can range from 10 percent to more than 50 percent (Bureau of Reclamation. September 2000). Once a district has completed a water system profile and/or water budget, the district should have a good indication of the amount of water that is lost due to seepage. The presence of hydrophytic vegetation next to canals and laterals, visible seepage, ponding next to canals and laterals can also indicate significant losses due to seepage. If a district experiences a 10 percent or more loss of water supplies because of seepage, the district should consider lining canals or replacing canals with pipes.

System-wide irrigation scheduling, rather than on-farm scheduling, may also contribute to water conservation. System-wide scheduling responds to a district's aggregated water demands and not to individual farm demands. The following figure illustrates how system-wide irrigation can result in water savings. The shaded areas represent individual farm demand and water deliveries, and the area under the curve represents system-wide demand and water deliveries.



Source: Bureau of Reclamation. September 2000.

Additional information on these water management measures can be found in the Bureau of Reclamation's guidebook for agricultural water conservation. (Bureau of Reclamation. September 2000. *Achieving Efficient Water Management. A Guidebook for Preparing Agricultural Water Conservation Plans*. Second Edition.)

C.10 Reuse and Recycling

Water reuse and recycling practices reduce production demands on the water system. An alternative water source for some systems is "gray water," or treated wastewater for nonpotable water uses. Districts should work with their nonresidential customers to identify potential areas for reuse or recycling. Some industries can substantially reduce water demand through water reuse (or multiple use) in manufacturing processes. Recycled wastewater can be used for some industrial purposes, irrigation, groundwater recharge, and direct reuse. Water quality and health concerns may limit reuse and recycling; districts are encouraged to discuss this measure with the appropriate regulatory agencies.

C.11 Water-Use Regulation

Districts, regardless of size, should consider water-use regulations to promote conservation. Water-use regulations can address:

- Restrictions on nonessential uses, such as lawn watering, car washing, filling swimming pools, washing sidewalks, and irrigating golf courses.
- Restrictions on nurseries, hotels, and restaurants.
- Standards for water-using fixtures and appliances.
- Bans or restrictions on once-through cooling, non-recirculating commercial car washes, laundries, and decorative fountains.

- Bans on certain types of water use or practice.
- Standards for new developments including fixtures and appliances, landscaping, drainage, and irrigation practices.

C.12 Integrated Resource Management

Supply-side technologies. The idea of integrated resource management is that water often is used jointly with other resources. Districts might have opportunities to consider and implement measures that can accomplish integrated resource management, where water conservation is jointly accomplished with the conservation of other resources. On the supply-side, the utility can institute operating practices (including various automation methods, strategic use of storage, and other practices) that achieve energy, chemical, and water savings. Source-water protection strategies, including land-use management methods, can be used to conserve water resources and avoid costly new supplies. Water and wastewater utilities can jointly plan and implement conservation programs to realize savings and share in the benefits.

Demand-side technologies. Integrative practices also can be accomplished on the demand side. Districts can conduct comprehensive end-use audits and jointly promote conservation practices by end-users. Large-volume users can work with the district to make adjustments to processes that reduce water and energy usage and wastewater flows, while saving other resources as well. Districts that provide wholesale water can work with wholesale customers to design a water conservation program that will be mutually beneficial.

WORKSHEET C-1: METERING

SOURCE METERS:

Percentage of source withdrawal with meters: _____

Schedule for testing source meters: _____

_____

_____

Number of additional source meters needed and installation schedule: _____

_____

_____

CONNECTION METERS

Customer Category	Number of Customers	Percent Metered	Meter Reading Frequency	Number of Meters Needed
Residential – single-family				
Residential – multi-family				
Commercial				
Industrial				
Irrigation –crop				
Irrigation – golf course, park, cemetery				
Livestock				
Hydropower				
Aquaculture				
Municipal				
Authorized nonaccount				
Other				
Other				

Calibration, testing, repair, and replacement program: _____

_____

WORKSHEET C-2: WATER ACCOUNTING AND LOSS CONTROL

Line	Item	Volume (gallons)
1	Total Source Withdrawals and Purchases	
	Adjustments to source water supply (per industry standards)	
2A	Adjustments for source meter error	
2B	Adjustments for change in reservoir or tank storage	
2C	Adjustment for transmission line losses	
2D	Adjustment for other source contributions or losses	
3	Total adjustments to source water (add lines 2A – 2D)	
4	Adjusted Source Water (subtract line 3 from line 1)	
	Metered Sales by User Category	
5A	Residential – single-family	
5B	Residential – multi-family	
5C	Commercial	
5D	Industrial	
5E	Irrigation –crop	
5F	Irrigation – golf course, park, cemetery	
5G	Livestock	
5H	Hydropower	
5I	Aquaculture	
5J	Municipal	
5K	Authorized nonaccount	
5L	Other	
5M	Other	
6	Total metered sales (add lines 5A – 5M)	
7	Adjustments for meter reading lag time	
8	Adjustments for meter error	
9	Adjusted total meter sales (add lines 6 – 8)	

Line	Item	Volume (gallons)
10	Nonaccount water (subtract line 9 from line 4)	
11	Metered and accounted, but not billed	
	Authorized Unmetered Water	
12A	Main flushing	
12B	Process water at treatment plant	
12C	Water quality and other testing	
12D	Storm drain flushing	
12E	Sewer cleaning	
12F	Street cleaning	
12G	Landscaping – large public areas	
12H	Firefighting , training, maintenance	
12I	Swimming pools	
12J	Construction sites	
12K	Other	
13	Total authorized unmetered water (add lines 12A – 12K)	
14	Total Unauthorized Losses (subtract line 13 from line 10)	
	Identifiable Water Losses and Leaks	
15A	Accounting procedure errors	
15B	Malfunctioning distribution system controls	
15C	Illegal connections and theft	
15D	Meter inaccuracy	
15E	Unavoidable water leaks	
15F	Avoidable water leaks	
16	Total identifiable water losses and leaks (add lines 15A – 15F)	
17	Unaccounted-for Water (subtract line 16 from line 14)	

WORKSHEET C-3: EVALUATING EFFECTS OF WATER RATE CHANGES

Line	Item	Value
1	Current price per gallon	$
2	Current revenue-producing volume	gallons
3	Current annual revenues (line 1 times line 2)	$
4	Conservation goal (reduction in water use)	gallons
5	Conservation goal as percentage of current annual revenue-producing gallons (line 4 divided by line 2)	%
6	Estimate price elasticity of demand	%
7	Percentage change in price needed to induce conservation (line 5 divided by line 6)	%
8	Adjustment to price to induce conservation	%
9	Revised price level (line 1 multiplied by (1.00 plus line 8)	$
10	Revised annual water usage (line 1 minus line 4)	gallons
11	Revised revenues (line 9 times line 10)	$
12	Annualized fixed costs	$
13	Annual variable costs for revised water usage	$
14	Revised revenue requirements	$
15	Net revenue effect (line 11 minus line 14)	$

WORKSHEET C-4: RESIDENTIAL WATER AUDIT CHECKLIST

Item	Inspected	Comments
METER		
Calibrate and flow test		
Leak test		
Report malfunctioning meters to maintenance personnel		
Sinks (Kitchen, bath, laundry, garage)		
Check faucet flow rate		
Install aerator or flow restrictor		
Check for leaks and drips		
Replace washers/repair leaks		
SHOWER AND BATH		
Check showerhead flow rate		
Install low-flow shower head or flow restrictor		
Check for drips and leaks		
Replace leaking plug or plug washer		
Repair or replace shower diverter valve		
TOILETS		
Check for low flow toilet		
Check for leaks (dye test)		
Clean or replace flapper valve		
Check adjustment of float arm		
Provide information on available rebates		
LAUNDRY		
Check for high-efficiency washing machine		
Provide information on available rebates		
OUTSIDE WATER USE		
Measure sprinkler flow rate		

Item	Inspected	Comments
Check for leaks in all irrigation systems		
Check sprinkler position		
Instruct homeowner on proper irrigation techniques		
Provide information on water-efficient landscaping including plant selection		
Provide information on the amount of water wasted from car washing and hosing down sidewalks and driveways		
Provide information on available rebates		
Provide information on effectiveness of pool covers and ways to eliminate back flushing		
Check for leaks in pool systems		

Appendix D: Guides and Handbooks

APPENDIX D: GUIDES AND HANDBOOKS[1]

American Water Works Association. *Before the Well Runs Dry. Volume I. A Handbook for Designing a Local Water Conservation Plan*. Denver, CO: American Water Works Association, 1984.

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California Urban Water Management Planning Act. Established AB797, 1983, Amended AB 2661, 1990; AB11X, 1991; AB 1869, 1991; AB 892, 1993; SB 1017,1994; AB 2853, 1994; AB 1845, 1995; SB 1011, 1995.

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Connecticut Department of Environmental Protection, et al. *Water Companies Planning Guidance for Water Conservation*. Connecticut Department of Environmental Protection, Connecticut Department of Health Services, Connecticut Department of Public Utility Control, Connecticut Office of Consumer Counsel, Connecticut Office of Policy and Management, December 1990.

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