# HAMMOND CONSERVANCY DISTRICT

# WATER MANAGEMENT PLAN

**Prepared for the**

**Hammond Conservancy District**
**Bloomfield, New Mexico**

**December 2002**

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# HAMMOND CONSERVANCY DISTRICT
# WATER MANAGEMENT PLAN

**LIST OF FIGURES (placed at the end of major sections)**

## LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AF | acre-feet |
| cfs | cubic feet per second |
| NEPA | National Environmental Policy Act |
| NHPA | National Historic Preservation Act |
| NRCS | Natural Resources Conservation Service |
| USBR | United States Bureau of Reclamation |
| WRCC | Western Regional Climate Center |
| WUA | *Water Use Analysis* report by the USBR, 2002 |

## 1.0 EXECUTIVE SUMMARY

The Hammond District has developed this Water Management Plan to assess the state of water management measures related to efficient use of project waters, and to identify, plan, and implement any improvements needed in that management.

Data from the *Water Use Analysis* produced for the District by USBR is used in this report to provide an analysis of the water supply and uses in the District, and to calculate the efficiencies of the various parts of the Hammond water system. The assessment of current management reveals a variety of significant measures that have increased overall efficiency including extensive canal lining, comprehensive data collection, education efforts, and progression to sprinkler application.

Public input was used to compile the most pressing issues for the Hammond District, and a set of goals to address those issues. Several water management options were developed to accomplish those goals, and the options were evaluated, modified, and narrowed in scope to a set of adopted measures, described below. These are only brief statements of the adopted measures which are explained in more detail in Section 11, which includes scheduling and cost considerations for their implementation.

**Measure 1 — Irrigation Technology Survey**: A voluntary survey will be conducted to determine the type and state of irrigation application equipment being used at present on each parcel in the District.

**Measure 2A — Irrigation Technology Brochure**: A brochure will be produced describing selected available technologies, sources of technical assistance, and possible sources of financial assistance. This brochure will be distributed to each irrigator in the District.

**Measure 2B — Irrigation Technologies Training:** The District will provide irrigation technology training annually (as part of the annual workshops described in Measure 3 below) to provide interested irrigators with more in-depth exposure to the technological options available to them.

**Measure 2C — Irrigation Consultation Visits:** The District will seek funding or in-kind assistance from USBR, NRCS, Extension, and other groups in order to offer free consultation visits by irrigation specialists to evaluate the technologies, scheduling, and crop management techniques used by irrigators, and suggest any needed improvements.

**Measure 3 — In-Service Training Workshops**: In-service training will be provided with an Annual Irrigation Workshop relying on local NRCS, Extension, NMSU, and other specialists.

**Measure 4 — New Irrigator Orientation Sessions**: The District will strongly encourage any landowner new to the District in the past 5 years to attend an orientation session, and new irrigators to attend a session after they arrive.

**Measure 5A — Promote Efficiency with the Water Management Bank:** The District will promote the use of the Water Management Bank as a means of rewarding efficient irrigators. District customers will be asked to provide feedback on use of the Bank, and any impediments to using the Bank will be explored and rectified if at all possible.

**Measure 6A — Review Ditchriders Procedures**: The District will monitor the effect on the ditchrider's effectiveness as each of the data access and automation improvements are made. In turn, the findings will be used to plan future technology improvements.

**Measure 6B — Test Alternative Schedules for Ditchriders:** Irrigators will be asked in a mailing if they would be interested in participating in a pilot project to test a 12-hour delivery schedule rather than the current 24-hour schedule.

**Measure 6C — Consolidate District Accounting Software:** The District will consider purchasing the software package (from Rim Rock Computing) identified by District staff that has the ability to monitor water use, parcel ownership, and finances.

**Measure 7 — Develop an Initial Water Shortage Plan:** The District will start discussion of a Water Shortage Plan.

**Measure 8 — Request Reclassification and Reallocation:** The District will request USBR to undertake a reclassification and reallocation on the Hammond District as soon as possible, and set up a procedure for performing these activities on a regular basis in the future.

**Plan Evaluation and Updating —** Progress toward implementing these adopted measures and meeting the Plan's goals, as well as any needed changes in the Plan will be considered annually during a Board of Directors meeting.

## 2.0 INTRODUCTION — Why has this plan been developed?

### 2.1 Objective and Development of this Plan

The overall objective of this plan is to help the Hammond District develop and implement a cost-effective, comprehensive water management strategy to achieve more efficient and effective water use over the next several years. To do this, a comprehensive and coordinated set of cost-effective water management measures has been assembled. This report will provide an explanation and rationale for these recommendations so that all residents of the Hammond District can recognize the opportunities that exist for more efficient use of our precious water resources.

**OBJECTIVE:**

**To help the Hammond District develop and implement a cost-effective, comprehensive water management strategy to achieve more efficient and effective water use.**

The process of developing this plan involves:

- analyzing present water sources and uses (**Sections 4 and 5**),
- determining the most pressing water management issues to be addressed (**Sections 6 and 7**)
- selecting a set of water management measures most feasible and relevant to the Hammond District needs (**Sections 8, 9, and 10**),
- developing an implementation plan (**Section 11**), and
- setting up procedures for monitoring, evaluating, and updating the plan (**Section 12**).

Public involvement has been, and continues to be critical to the development and implementation of this plan through public meetings, interviews, written comments, as well as input from area citizens already incorporated in related plans and reports. The end result of this process is envisioned to be a water use system that is **resilient** — capable of coping with varying supplies and demands, **efficient** in its use of the available water resources, and **appropriate** — equitably meeting the needs and expectations of the people of the area.

### 2.2 Conservation and Efficiency

To paraphrase the Bureau of Reclamation's description of water conservation, it includes all the means used to:

- reduce water consumption,
- reduce diversions or withdrawals,
- reduce loss or waste of water,
- increase water use efficiency, and
- increase reuse or recycling of water.

But the term is still confusing — conservation takes on many different meanings in different situations. It is useful to recognize two distinctly different ways of saving water — "doing without" versus "getting the most out of each gallon." "Doing without" around the home may mean brown lawns or skipping needed showers, and on the farm may mean selling cattle or fallowing fields. These may be crucial tools for coping with an unexpected drought or supply breakdown, but not the sort of measures we plan on using routinely.

On the other hand, the term **water use efficiency** refers to "getting the most out of each gallon" — actually getting the job done with less water, or getting more done with the same amount of water. Rarely do people really care how much water comes into their houses or onto their farms, as long as they have enough for washing, bathing, and growing crops.  If a technology or management practice can provide what people want — water-related services in other words — with less water, truly efficient water use results.

If an old 5 gallon-per-minute showerhead is replaced with a 2.5 gallon-per-minute model, and **if** the consumer gets clean and enjoys it, it is efficient.  If one can't get the soap off, is too cold, or otherwise doesn't like it, it may have conserved water by using less, but is not efficient — it hasn't provided for the consumer's needs.  If an irrigation improvement gives the same crop yields with less water or greater yields with the same amount of water — and nothing else is adversely affected —water use efficiency has increased.  As explained later, one must consider all resource use, including energy, labor, and money in determining the feasibility, benefits, and cost-effectiveness of water efficiency measures.

Emergency measures, such as rationing and other curtailments, are a critical part of overall water management, but the focus here will be on meeting the needs and expectations of the Hammond District's irrigators and reducing the need for these emergency measures.

**Numerators and Denominators**

Another way to look at efficiency is with simple mathematics.  Efficiency is a ratio between the work done or benefit derived to the amount of water used.  As we all know, you can increase the value of a fraction by increasing the numerator (top value) or by decreasing the denominator (bottom value) or both.

$$\text{Water Use Efficiency} = \frac{\text{Benefit Gained from Water Used}}{\text{Amount of Water Used}}$$

So, more efficient water use can be achieved by getting more done with the same amount of water, or by getting the same amount done with less water, or both.

Since this report is concerned primarily with agricultural water use, we can define agricultural water use efficiency in its simplest form as follows:

**Agricultural water use efficiency means getting the same, or even better yields with less water or better yields with the same amount of water.**

## 2.3 Water Management and Efficiency

The Bureau of Reclamation urges water districts to put water efficiency efforts in the context of wise water management. Neither can be considered in isolation. Benefits of even the best water efficiency measure will be largely lost without good overall management, and improvements in a district's management of its water are very likely to improve efficiency. This plan will, therefore, include those water management issues that offer opportunities to get the most from precious water resources.

## 2.4 Relationships With Other Plans and Programs

The preparation of this report relied heavily on the recently updated *Hammond Conservancy Water Use Analysis* finalized by the Bureau of Reclamation in 2002. This analysis contained much of the data needed for consideration of water budgets in Section 5, where a summary of the findings can be found as well.

## 2.5 Acknowledgments

Many people helped with the preparation of this plan. The staff, Board of Directors, and irrigators — especially Dan Smeal — of the Hammond District provided invaluable assistance and advice, as did Pat Page and Rege Leach of Durango USBR. As mentioned above, the USBR's *Water Use Analysis*, prepared by Chuck Jachens, has been a very useful resource. It should also be noted that some of the water efficiency and other explanations in this report came from work done largely by the author on two previous water management plans — *San Juan County Water Management and Conservation Plan* and *Western La Plata County Water Management and Conservation Plan* — both prepared by Wright Water Engineers, Inc. under USBR cooperative agreements.

# 3.0 DISTRICT DESCRIPTION — What is the Hammond District?

## 3.1 The Study Area

The area of concern in this plan is the Hammond Conservancy District, located in eastern San Juan County, New Mexico. The District serves about 4000 acres of land on the south side of the San Juan River from a point about 2 miles upriver from Blanco down about 20 miles to just east of Farmington.

San Juan County, New Mexico comprises the far northwestern corner of New Mexico — a land of great beauty, contrasts, and many points of interest. The San Juan River runs from the County's northeast corner, as Navajo Reservoir, across the more populated northern portions, and exits in the northwest corner near the Four Corners, where New Mexico, Arizona, Colorado, and Utah meet. Most of the County's western half is part of the Navajo Nation, with a checkerboard of Navajo, Federal, and other lands in the eastern half south of the Hammond District. The New Mexico portion of the Ute Mountain Ute reservation lies just northwest of Farmington. Although outside the County, part of the drainage area feeding into the Hammond District area lies within the Jicarilla Apache Indian Reservation to the east.

Points of interest include the Four Corners Monument in the northwest, Aztec and Salmon Ruins just north of the Hammond District, Chaco Canyon National Park in the southeast, as well as Bisti Wilderness, Shiprock, Angel Peak, and numerous other natural and cultural sites.

Mining and energy production are major economic activities in the region in addition to agriculture. Oil and gas extraction and coal and uranium mining are carried out throughout the larger San Juan Basin and San Juan County in particular. Coal-fired power plants are located here to take advantage of nearby coal mines. Water is needed for many of these activities, and the variations in these needs over time can create interesting competition with other uses.

### 3.2 Topography, Soils, and Climate

The Hammond District consists primarily of the floodplain just south of the San Juan River extending in elevation from about 5570 feet at the diversion dam just upstream from Blanco to about 5000 feet just east of Farmington. Several washes, most normally dry at the surface, flow from the uplands across the project lands to the San Juan River carrying occasional flood waters and considerable sediment. Alluvium from the San Juan River and these washes cover the floodplain. The bedrock in the District generally consists of San Jose, Naciemento, Ojo Alamo, and Kirtland formations. (USBR, 1993)

Irrigated soils in the Hammond District belong to the “Fruitland-Riverwash-Stumble” mapping unit according to the *Soil Survey of San Juan County* (Soil Conservation Service, 1980). This generalized mapping unit consists of soils that are mostly well drained, formed from alluvium from sandstone and shale, and are usually of a sandy loam to loamy sand texture in the surface layer.

The climate of the area is well represented by records from the Bloomfield climate station, Bloomfield 3 SE. Average temperatures over the 1971 to 2000 period range from a high of 42F and low of 19F in January to a July average high of 91F and low of 60F. The growing season averages about 160 days at 32F or above. Precipitation is rather sparse, averaging slightly over 9 inches with the low in June and the wettest period in July and August. However, it might be claimed that a “normal” year never happens here — the variability from year-to-year, both in total amounts and when it occurs during the year is very high, as seen in the following section. This precipitation regime will be described in more detail in Section 4. (WRCC Website)

Irrigators have come to depend on the mountain snow pack feeding the San Juan River. They also welcome the summer rains (unless the hay is down) that usually begin to increase in frequency during July as the summer monsoon season begins.

### 3.3 Hammond District History

In centuries past, early inhabitants farmed the rich floodplain of the San Juan River where the Hammond District is today as documented at the Salmon Ruins site just across the river to the north. Records indicate that white settlers first began irrigating out of the San Juan in the Hammond area in the1870s. By the turn of the century, about 2000 acres upriver from Bloomfield were being irrigated, and most of that from what was called the "Hammond Ditch," a name which remains today. (USBR, 1991)

Figure 3-1. shows the annual precipitation totals for the northwestern part of New Mexico from 1895 to the present. Local precipitation varied greatly from year to year, and varying snow pack accumulation and melting patterns caused many San Juan River floods until Navajo Dam was constructed in the early 1960s. These early floods, shown in Figure 3-2., proved so disastrous to irrigation structures on the floodplain, that most irrigation and farming stopped by about 1916. Records indicate some sporadic irrigation since that time, but the next significant collective effort was the Kutz Canyon Water Users filing in 1945 to irrigate up to 2285 acres. (USBR, 1991)

Hammond, Inc., formed in 1939, was initially unsuccessful in gaining USDA support for an irrigation project, but continued efforts and adjudication of water rights throughout the 1940s and 50s set the stage for signing of a Repayment Contract between the Hammond Conservancy District and the US Government in 1959 as part of the Colorado River Storage Project. The first water was delivered in April of 1962. A more complete history may be found in the Hammond "Project History" report of 1991 — the last in the annual series. (USBR, 1991)

### 3.4 Today's Agriculture

Agricultural production is a major land use in San Juan County ranging from intensive irrigated crop production to widespread rangeland grazing. A strip of irrigated cropland and pasture extends along much of the San Juan River corridor, and the extensive Navajo

Irrigation Project south of Farmington is fed by waters from Navajo Reservoir. Much smaller scattered irrigated areas are fed by springs, small streams, and floodwaters. The Hammond District is fortunate to have a very dependable water supply from the San Juan River and Navajo Dam.

LAND IRRIGATED: Figure 3-3. shows the yearly amounts of land irrigated in the Hammond District from 1980 to 2000 as reported on line 13 (“Acres Irrigated”) of the annual crops report, USBR Form 7-2045, and compiled in the *Hammond Water Use Analysis*, hereafter referred to as WUA (USBR, 2002). It should be noted that the WUA text used Line 11 in the crop reports, “Harvested Cropland and Pasture,” for its description of “Irrigated Acreage” and did not include the difference which is line 12, “Cropland Not Harvested and Soil Building.” This is understandable, since the WUA is largely concerned with calculating crop consumptive use, and specific crop types for line 12 lands are not reported (see WUA for full listing of entries on Form 7-2045). The difference is relatively small, but important to note in looking at historically irrigated area data. The differences are shown in Figure 3-4.. The maximum irrigated land area under the District’s repayment contract, 3933 acres, is indicated on Figure 3-3. and Figure 3-4.

CROPS GROWN: Approximately 93% of the irrigated acreage harvested in 2000 in the Hammond District was used to grow forage and pasture crops (Figure 3-5.). As Figure 3-6. and Figure 3-7. show, the distribution of crop types has not changed greatly over the last two decades.

FARM NUMBERS AND CHARACTERISTICS: Part-time farms comprise the majority of the operations in the Hammond District, with little change in numbers of full-time farms but increasing part-time ones over the past few years (Figure 3-8.). Data compiled for Appendix 2 of the WUA, shows that a majority of the District’s cropland fields are 10 acres or less, and furthermore, most farms are 10 acres or less in size.

### 3.5 Water Management

AUTHORITY AND GOVERNANCE: The Hammond Conservancy District is a New Mexico non-profit organization, with a 5-member Board of Directors selected by the District's water users:

- Myron E. Crockett — President
- R. Russell Smith, Secretary — Treasurer
- Jack M. Moore
- Jack Reid
- Jerry L. Thomas

District Staff consists of:

- Teresa Lane, Business Manager
- Jack K. Moore, O & M Manager
- Elliot Benally, Ditchrider

The Repayment Contract # 14-06-400-1022, dated 20 October 1959, is the basis of the District's operation as a federal water project. See Section 15.2 for a summary of District guidelines for irrigators.

WATER RIGHTS: The USBR (USBR,1993) lists the following water rights for Hammond Project irrigation purposes.

**Table 3-1: Hammond Project Water Rights (after Table III-1, USBR, 1993)**

| Owner | Comments | New Mexico File # | Priority Date | Amount (AF) |
|---|---|---|---|---|
| United States | | 2848 | 6/17/55 | 23,000 |
| Hammond District | Lawson Ditch | 2475 | 6/1/36 | 535.7 |
| Hammond District | Kutz Canyon Water Users | 2593 | 3/12/47 | 3168.9 |
| | | | TOTAL | 26,704.6 |

FACILITIES: Project water is diverted from the San Juan River at the Hammond Diversion Dam roughly two miles upriver from Blanco. (See District map, Section 16) This dam is a rockfill overflow weir designed for a capacity of 16,300 cfs. The 27 mile long Main Gravity Canal has a capacity ranging from 90 cfs at the head to 5 cfs at the end. About six miles below the Hammond Diversion Dam, a pumping plant driven by a hydraulic turbine with a 30 foot drop moves up to 18 cfs of water about 53 feet up to the level of the East and West Highline Laterals. A conventional pump station just uphill from the turbine is available as needed to provide greater flows for the East Highline Lateral. An additional pump may also be needed for the West Highline Lateral in the future.

Past the turbine, the Main Canal delivers water to turnouts and short laterals to the end of the project lands just east of Farmington for a total canal length of about 27 miles. The East and West Highline Laterals have capacities of about 10 and 12 cfs respectively, and lengths of 2.3 and 3.2 miles respectively. A 10 cfs Gravity Extension Lateral extends about 4.7 miles west of the pumping plant intake location and serves lands above the Main Canal and below the West Highline. (USBR, 1991 and USBR, 1993)

Water is spilled at several locations as required as canal capacity decreases downstream. The first spill downstream of the hydraulic turbine, where water used to operate the turbine re-enters the Main Canal, is Armenta Canyon. As will be detailed in Section 5 , the Armenta Canyon spill is usually the largest annually, followed by Sullivan, Horn, and Store (or Stewart). A major project to add concrete lining to unlined canal and lateral sections was undertaken in the late 1990s as a salinity control measure with a resulting decrease in seepage. (USBR, 2002) Most of the canal and laterals are now concrete-lined.

LAND IRRIGATED: As described earlier, Figure 3-3 shows the actual irrigated acreage from 1980 to 2000. Hammond's contract with USBR limits the land irrigated at any one time to 3933 acres (USBR, 2002). Lands within District boundaries deemed eligible by USBR for irrigation or "irrigable" (called "Class A" lands by the District) exceed this limit by somewhat over 600 acres at present due to USBR reclassifications over the past few years. Therefore some Class A lands are "serviced" and some are eligible for project water, but "unserviced."

WATER PRICING: The Hammond District has several components in its current water pricing system:

- An "Account Charge" of $50 per irrigator (including each of those making up a "subdivision").
- An "Assessment" of $8.00 per acre for serviced land (the District's total is matched by County ad valorum taxes on those non-irrigators in the assessment district).
- A "Water Charge" of $16.50 per acre of land irrigated (whether the full water duty is used or not).
- Fees associated with the "Water Management Bank" consisting of a $50 administrative fee per application to lease and withdraw water from the system, and a $33 charge per acre for water.

WATER MANAGEMENT BANK: The Hammond District initiated a Water Management Bank in 2000 to "promote the beneficial use of water and conservation" (see the Water Bank Rules and Administrative Guidelines in Section 15). Water deposits in the Bank can come from three sources:

- The District may deposit water from any irrigator who has not paid fees for a year.
- The District may also deposit water from an irrigator who has not used the water for 4 consecutive years.
- An irrigator who has not used water (for less than 4 years) or who "conserves" water, may ask that the water be deposited.

In the third case above — that of a voluntary deposit — the depositor will pay the water charge on water deposited and will be reimbursed when that water is actually leased from the Bank. An irrigator leasing water will pay a $50 administrative fee and $33 per acre.

### 3.6 Legal, Institutional, & Environmental Considerations

The primary legal and institutional constraints affecting the Hammond District include the District's water rights under New Mexico law, and the "Repayment Contract" between the District and the U.S. government dated 20 October 1959, as mentioned above.

Environmental considerations include irrigation-related wetlands, the operation of the Navajo Dam for endangered species, and Hammond diversions from, and return flows to, the San Juan River.

**Figure 1. Figure 3-1.**

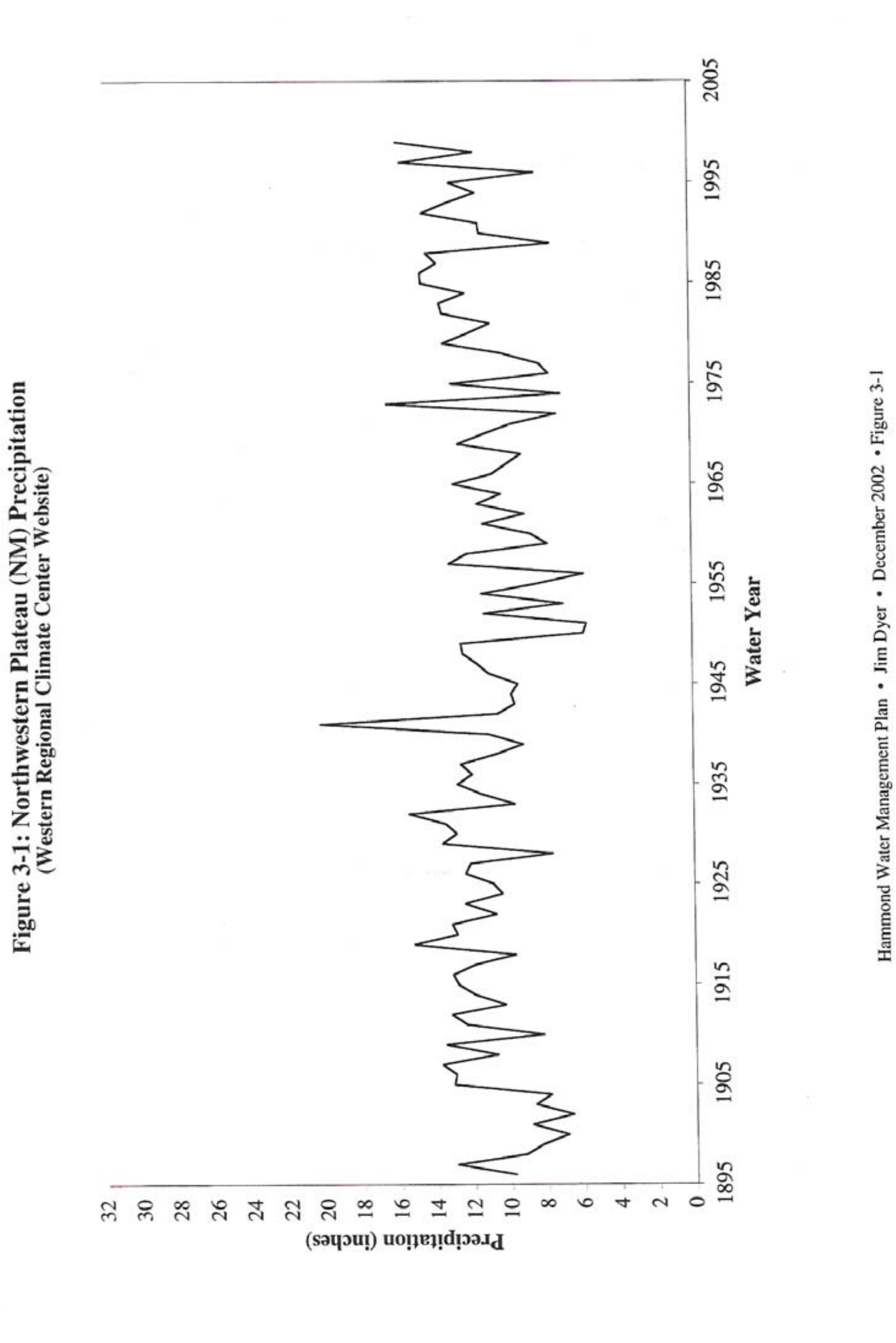


**Figure 2. Figure 3-2.**

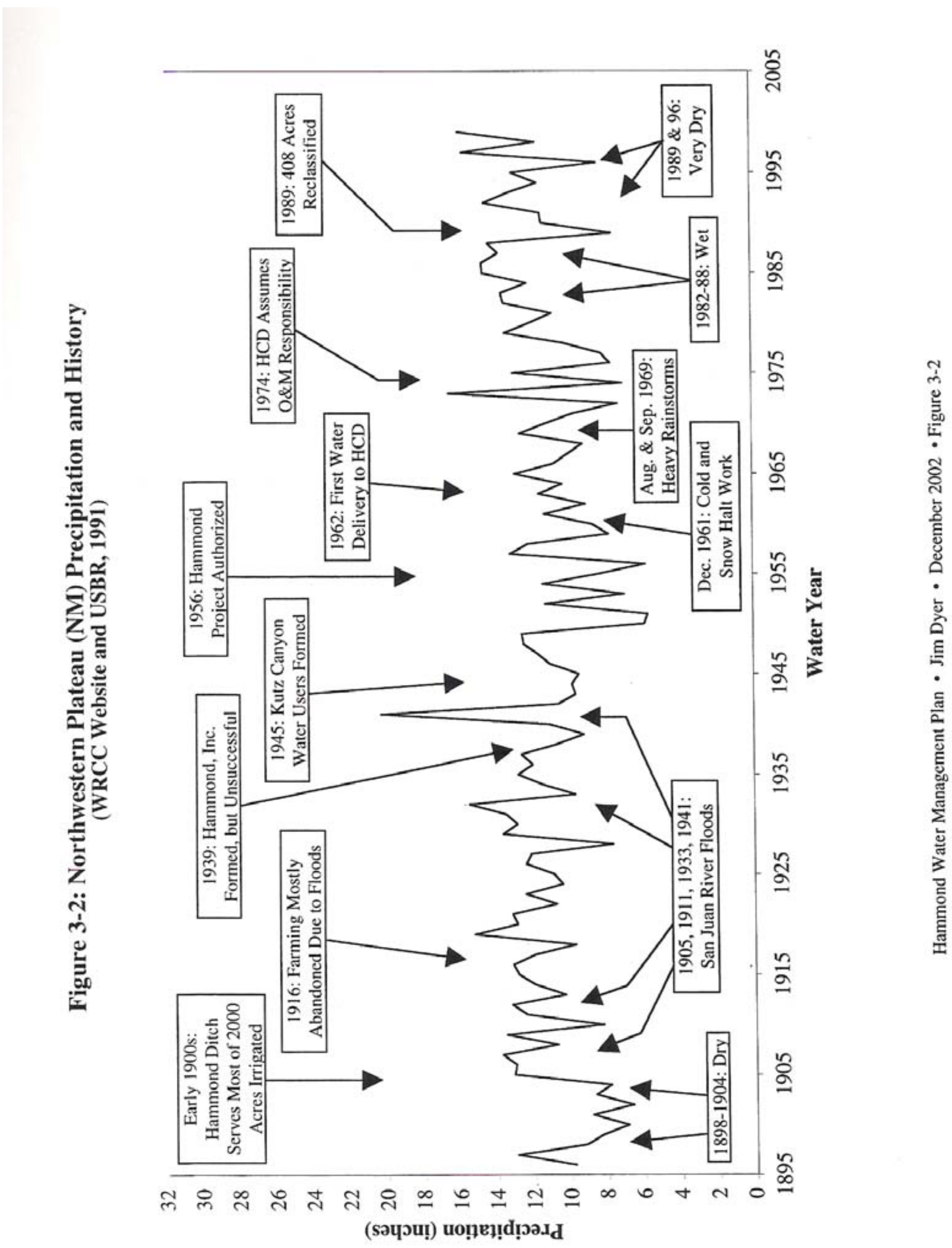
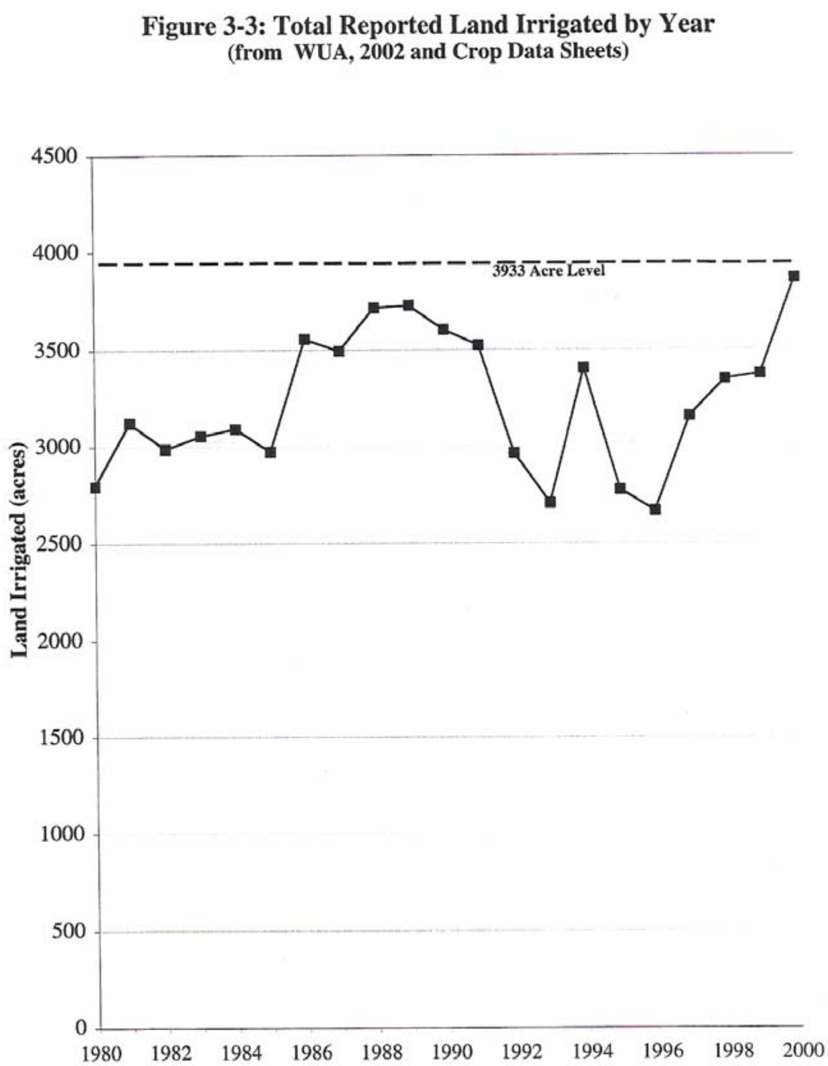


**Figure 3. Figure 3-3.**




Hammond Water Management Plan • Jim Dyer • December 2002 • Figure 3-3

**Figure 4. Figure 3-4.**

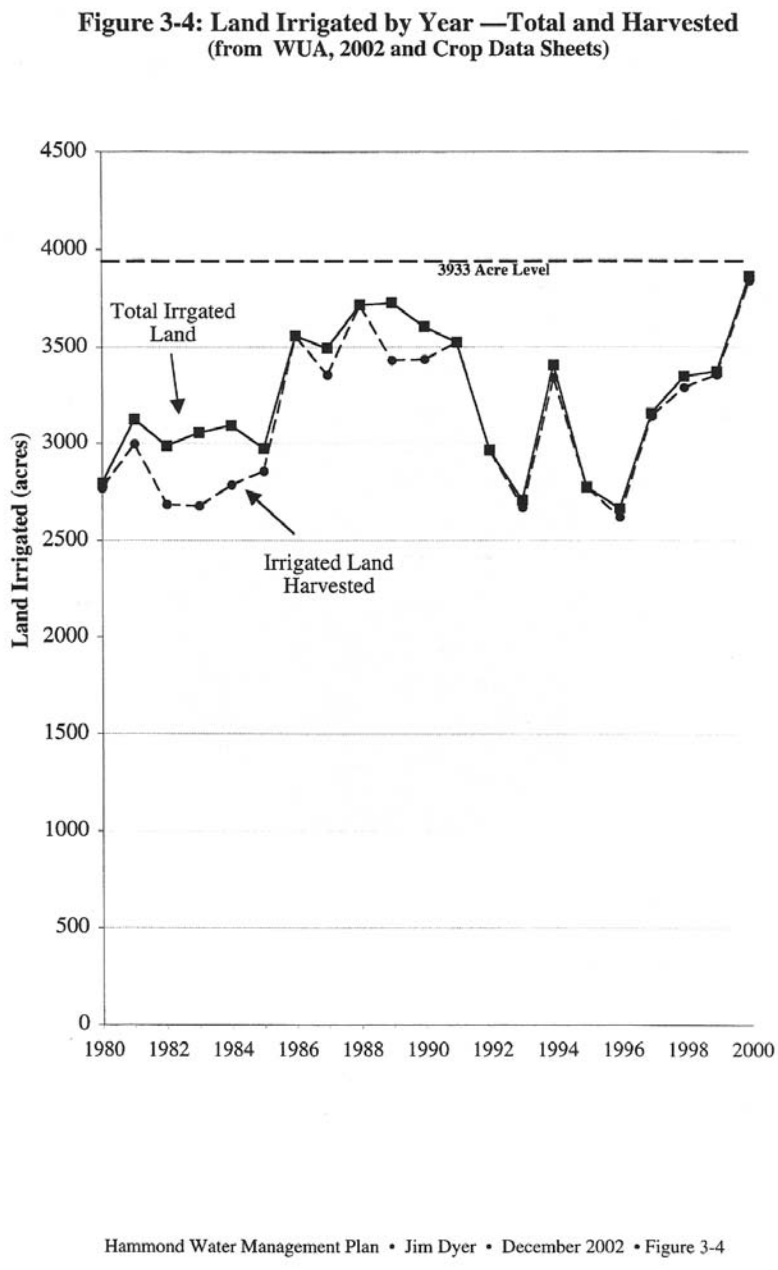
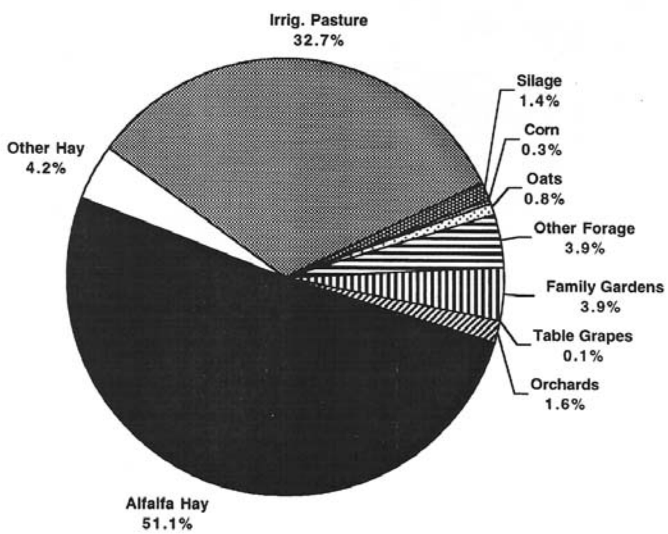


**Figure 5. Figure 3-5.**

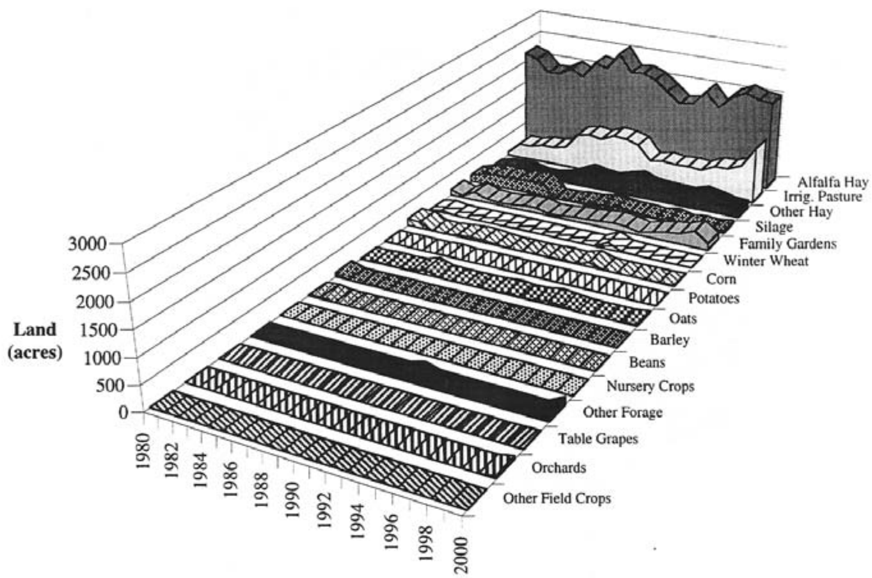
Figure 3-5: Year 2000 Land in Crops Harvested
(from WUA, 2002)




Hammond Water Management Plan • Jim Dyer • December 2002 • Figure 3-5

**Figure 6. Figure 3-6.**

**Figure 3-6: Land in Crops Harvested by Year**
**(From WUA, 2002)**




Hammond Water Management Plan • Jim Dyer • December 2002 • Figure 3-6

**Figure 7. Figure 3-7.**

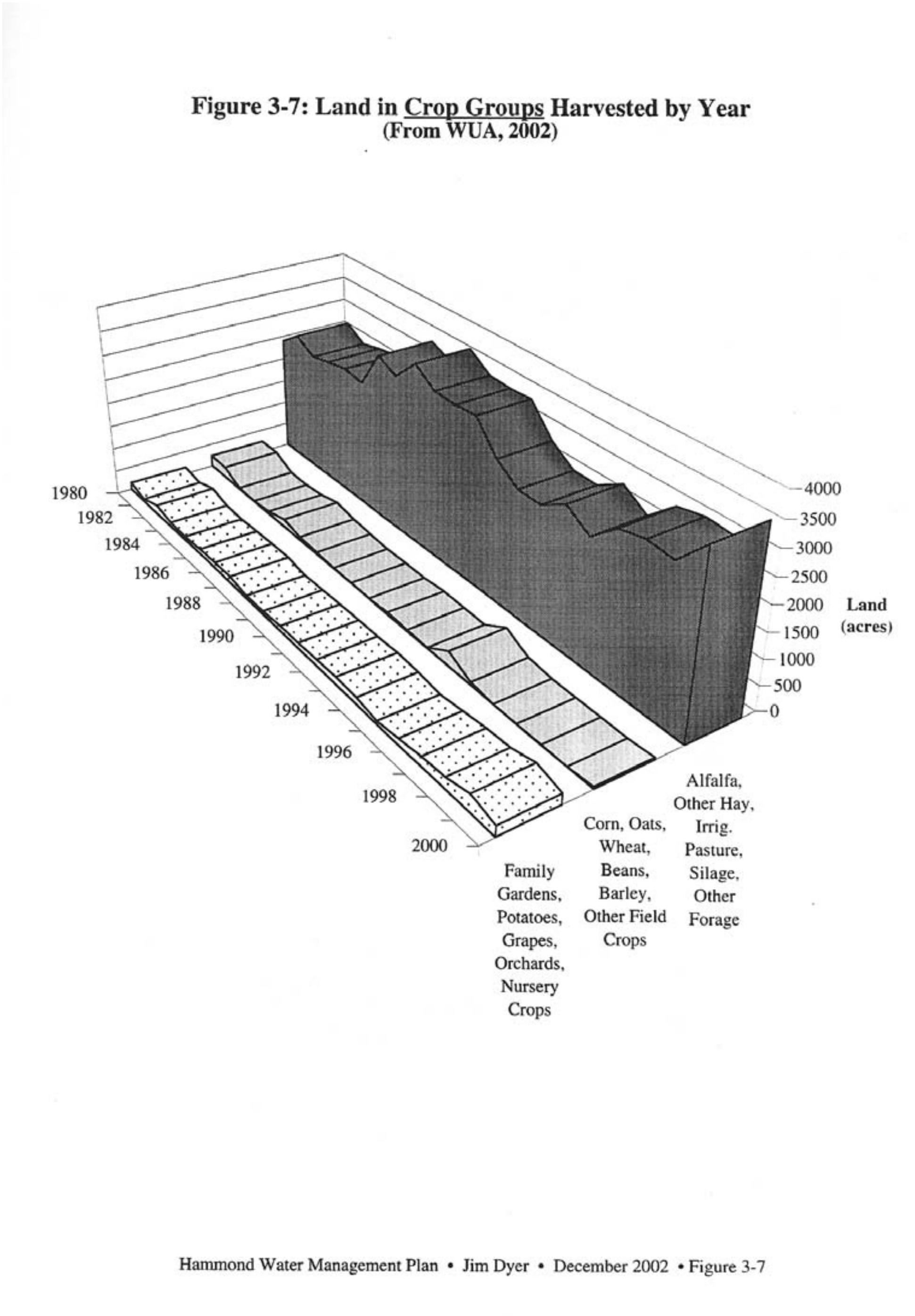
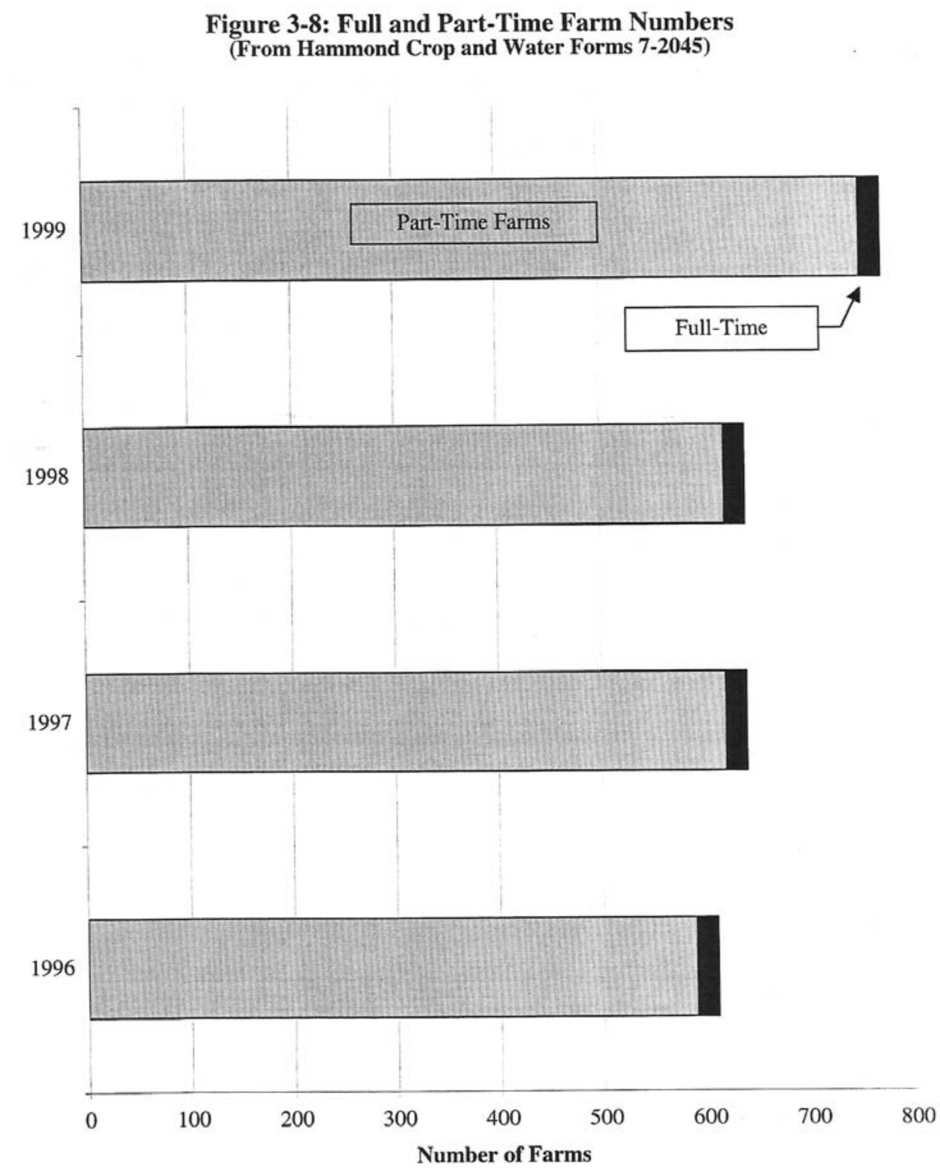


**Figure 8. Figure 3-8.**




Hammond Water Management Plan • Jim Dyer • December 2002 • Figure 3-8

## 4.0 WATER RESOURCE USE INVENTORIES — What is the current water supply?

| |
|---|
| In this section, the water supply for the Hammond District will be reviewed, and the water diverted for use will be quantified. Later sections will compare these diversions with crop water demands and look at ways of using this precious supply most effectively and efficiently. |

### 4.1 Precipitation

Precipitation is a good place to start in looking at the hydrologic cycle. As mentioned in the previous section, the annual precipitation at Bloomfield is 9.31 inches for the 1971 to 2000 period (the latest three decades of data are generally used for computing “normals.”) In this area, the normal wettest month and driest month both occur during the growing season with the driest month usually being June and the wettest being August (see Figure 4-1). Figure 4-2 shows how monthly normals vary from the much more moist Navajo Dam station northwest of the District to the slightly drier Farmington Ag Science Center to the west.

Dramatic variations from year to year are shown in Figure 3-1. of the previous section depicting precipitation for northwest New Mexico from the late 1800s to the present. In fact, the variations from year to year can be as much as the total precipitation itself. Figure 4-3 shows the more recent variability in more detail specifically for the nearby Bloomfield station. All this can have profound impacts on agricultural production — irrigated or not. Figure 4-4 shows that over the 1914-2000 period, Bloomfield has had occurrences of zero precipitation in each month of the year except July, but even in July it has been as low as 0.04 inches.

Rainy days do occur in the Hammond District area, but amounts are usually quite low. Figure 4-5 shows that a “normal year” (they really never occur) has from two to six days per month of measurable rain during the growing season, but one can expect only one day of half an inch or more in July and again in August.  The average amount of rain on any specific day of the year, as depicted in Figure 4-6, reflects the variability that characterizes the later summer season.

## 4.2  Evaporation

Evaporation is relatively high in the Hammond area due to the high temperatures, abundant sunshine, low humidity, and vigorous winds.  Pan evaporation measurements are usually made in a four-foot diameter metal pan mounted slightly above the ground (Class A Pan Evaporation).  A rough guide is that about 75% of the pan evaporation is what one would expect from wet soil or a shallow body of water (WRCC Website).  For an indication of how much water can potentially evaporate if the soil remains moist, Class A Pan Evaporation for the Farmington Ag Science Center is shown in Figure 4-7, with a total for April through October of about 70 inches. (NMSU, 2001).  Since wind, solar radiation, and temperatures are the main factors determining potential evaporation, NMSU's publication: "Thirty Years of Climatological Data: 1969-1998" should be consulted for more details on these parameters.  More specific discussion of evaporation can be found in Section 5.

## 4.3  Groundwater Resources

Since groundwater is not a significant source of irrigation for the Hammond District, groundwater resources will not be included in this report.

## 4.4  Stream Flow Resources

The surface water flows in the area consist mainly of the San Juan River and the dry washes flowing from canyons originating south of the District.  The San Juan River flow has been modified by the construction from 1958-63 of Navajo Dam located just upstream from the Hammond District.  Navajo Reservoir has a surface of 15,610 acres, and a capacity of 1.7 million AF (USBR, 2001).

The San Juan River originates high in the San Juan Mountains and flows into Navajo Reservoir. Table 4-1 details the monthly flows of the San Juan at Archuleta (just upstream from the Hammond Diversion) for the last 45 years. The total flows for each year in Figure 4-8 indicate the high annual variability. Average monthly flows are shown in Figure 4-9. For the first thirty years or so, flows from Navajo Reservoir were reduced in the Spring and enhanced during the rest of the year. In the early 1990s, flows were adjusted to allow for higher Spring releases to aid endangered fish. (USBR, 2001) Figure 4-10 shows these seasonal changes over the years for January and June of each year.

**Table 4-1: Monthly Streamflow (in cfs) for San Juan River near Archuleta, NM** (from USGS Website: waterdata.usgs.gov)

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1955 | 197 | 230 | 446 | 760 | 2,144 | 2,007 | 687 | 1,083 | 472 | 317 | 278 | 247 |
| 1956 | 261 | 256 | 778 | 1,323 | 2,823 | 1,964 | 403 | 374 | 188 | 195 | 191 | 143 |
| 1957 | 216 | 543 | 742 | 2,018 | 3,612 | 8,064 | 5,311 | 2,669 | 1,125 | 1,095 | 1,135 | 712 |
| 1958 | 355 | 924 | 1,247 | 4,688 | 7,476 | 4,541 | 689 | 569 | 674 | 413 | 284 | 220 |
| 1959 | 178 | 261 | 293 | 621 | 1,416 | 1,408 | 285 | 560 | 260 | 969 | 648 | 317 |
| 1960 | 234 | 272 | 2,849 | 4,034 | 3,140 | 3,895 | 895 | 404 | 379 | 420 | 272 | 232 |
| 1961 | 190 | 282 | 702 | 1,900 | 3,130 | 2,044 | 612 | 849 | 983 | 842 | 572 | 295 |
| 1962 | 251 | 748 | 836 | 4,061 | 3,708 | 2,768 | 627 | 479 | 316 | 298 | 240 | 162 |
| 1963 | 115 | 149 | 238 | 517 | 305 | 316 | 329 | 353 | 338 | 389 | 399 | 390 |
| 1964 | 283 | 229 | 207 | 244 | 551 | 1,376 | 1,755 | 780 | 439 | 460 | 346 | 524 |
| 1965 | 1,467 | 1,661 | 843 | 1,429 | 2,249 | 3,614 | 1,656 | 2,215 | 1,885 | 2,131 | 3,018 | 2,886 |
| 1966 | 2,733 | 1,684 | 1,855 | 3,040 | 2,103 | 458 | 456 | 472 | 454 | 1,481 | 793 | 409 |
| 1967 | 409 | 804 | 1,131 | 389 | 279 | 300 | 320 | 1,010 | 986 | 350 | 355 | 344 |
| 1968 | 303 | 350 | 292 | 1,015 | 792 | 474 | 492 | 626 | 790 | 570 | 383 | 397 |
| 1969 | 645 | 1,985 | 1,525 | 1,852 | 1,901 | 1,980 | 1,603 | 1,167 | 1,283 | 1,561 | 1,366 | 1,459 |
| 1970 | 824 | 1,989 | 1,477 | 441 | 469 | 498 | 505 | 634 | 1,320 | 1,806 | 1,729 | 1,907 |
| 1971 | 2,290 | 2,164 | 1,101 | 502 | 499 | 492 | 501 | 498 | 502 | 402 | 306 | 1,067 |
| 1972 | 1,506 | 1,468 | 1,506 | 818 | 502 | 508 | 498 | 627 | 624 | 518 | 499 | 1,016 |
| 1973 | 1,149 | 1,743 | 476 | 500 | 2,170 | 3,066 | 4,321 | 3,508 | 2,674 | 1,950 | 1,971 | 1,947 |
| 1974 | 1,681 | 1,177 | 1,021 | 987 | 927 | 641 | 586 | 700 | 702 | 518 | 471 | 492 |
| 1975 | 525 | 483 | 508 | 1,380 | 2,405 | 2,423 | 2,449 | 1,833 | 1,550 | 1,458 | 1,428 | 1,566 |
| 1976 | 1,251 | 933 | 915 | 702 | 1,428 | 1,379 | 544 | 608 | 666 | 478 | 462 | 1,185 |
| 1977 | 1,218 | 663 | 516 | 513 | 556 | 603 | 560 | 572 | 525 | 533 | 512 | 471 |
| 1978 | 496 | 522 | 507 | 524 | 526 | 476 | 488 | 554 | 634 | 491 | 507 | 507 |
| 1979 | 499 | 579 | 1,605 | 4,768 | 4,960 | 5,169 | 5,125 | 1,858 | 759 | 760 | 549 | 1,686 |
| 1980 | 1,639 | 1,719 | 2,358 | 1,532 | 1,958 | 1,198 | 991 | 1,282 | 1,208 | 1,172 | 1,416 | 1,370 |
| 1981 | 1,643 | 1,128 | 648 | 445 | 496 | 571 | 800 | 867 | 896 | 885 | 589 | 598 |
| 1982 | 670 | 491 | 729 | 1,424 | 1,885 | 1,701 | 1,201 | 1,026 | 1,104 | 1,038 | 901 | 1,479 |
| 1983 | 1,830 | 1,739 | 2,073 | 2,667 | 1,722 | 1,293 | 1,592 | 1,042 | 1,102 | 1,117 | 990 | 1,081 |
| 1984 | 1,864 | 2,362 | 1,881 | 1,530 | 1,903 | 887 | 869 | 856 | 1,043 | 1,355 | 1,622 | 1,819 |
| 1985 | 1,810 | 2,150 | 2,617 | 3,671 | 4,962 | 4,695 | 1,835 | 1,186 | 1,476 | 1,123 | 2,434 | 2,625 |
| 1986 | 2,768 | 1,729 | 1,411 | 1,377 | 1,227 | 2,249 | 3,106 | 2,415 | 2,022 | 1,620 | 2,468 | 2,745 |
| 1987 | 2,741 | 2,382 | 2,909 | 3,957 | 3,442 | 4,849 | 3,559 | 783 | 797 | 651 | 612 | 614 |
| 1988 | 592 | 610 | 632 | 622 | 624 | 650 | 689 | 597 | 558 | 591 | 647 | 649 |
| 1989 | 651 | 658 | 640 | 640 | 666 | 673 | 620 | 628 | 621 | 618 | 622 | 558 |
| 1990 | 509 | 516 | 521 | 527 | 537 | 527 | 509 | 499 | 550 | 568 | 543 | 518 |
| 1991 | 533 | 542 | 554 | 942 | 1,922 | 641 | 610 | 604 | 604 | 625 | 635 | 576 |
| 1992 | 530 | 581 | 595 | 2,127 | 3,575 | 2,784 | 694 | 622 | 634 | 600 | 527 | 568 |
| 1993 | 576 | 841 | 4,216 | 4,445 | 2,871 | 3,299 | 731 | 634 | 625 | 612 | 734 | 765 |
| 1994 | 738 | 545 | 522 | 627 | 3,489 | 4,300 | 1,947 | 631 | 611 | 605 | 558 | 532 |
| 1995 | 544 | 516 | 1,616 | 2,748 | 4,312 | 4,397 | 1,230 | 812 | 793 | 788 | 776 | 733 |
| 1996 | 379 | 494 | 498 | 489 | 621 | 2,173 | 613 | 624 | 622 | 638 | 326 | 265 |
| 1997 | 264 | 258 | 1,051 | 971 | 2,955 | 4,036 | 1,100 | 609 | 612 | 620 | 619 | 757 |
| 1998 | 855 | 851 | 644 | 933 | 3,978 | 2,537 | 596 | 588 | 560 | 553 | 572 | 547 |
| 1999 | 572 | 601 | 570 | 544 | 1,334 | 2,562 | 534 | 3,052 | 3,241 | 740 | 503 | 491 |
| 2000 | 498 | 500 | 507 | 487 | 549 | 1,517 | 596 | 850 | 711 | 651 | 523 | 522 |
| **Avg** | 902 | 942 | 1,105 | 1,559 | 2,067 | 2,131 | 1,220 | 983 | 890 | 817 | 812 | 878 |

## 4.5 Water Quality

The primary water quality issue for this report is that of dissolved salts. The addition of salt to the San Juan River waters — known as salt loading — can occur as a result of water from canal seepage and deep percolation in fields picking up naturally-occurring salts from saline shales and soils formed from those shales. As irrigation water evaporates in fields, salts are left behind in the soils, ready to be leached away by subsequent irrigations, either to lower portions of the soil profile, or eventually back to the river. In addition, salt concentration can occur when the water is reduced in the river while the actual amount of salt is not reduced — a result of the evaporative consumptive use of irrigation waters. The canal lining projects in Hammond, described later, serve to reduce salt levels both by reducing canal seepage and consumptive use. (USBR, 1993).

## 4.6 Diversions for Irrigation

Diversions from the San Juan River for the past 20 years for the Hammond District are shown in Figure 4-11. Over the 1980 to 2000 period, total “Head of Canal” diversions for the Hammond District ranged from a low of 28,139 AF in 1980 to 32,790 AF in 1987. It should be noted that a significant portion of this diversion is required to operate the hydraulic turbine, essentially a non-consumptive use, the magnitude of which is addressed comprehensively in the *Water Use Analysis* report (USBR, 2002). These diversions will be compared in detail to crop consumptive use, operational losses, and other uses in the following section.

**Figure 9. Figure 4-1**

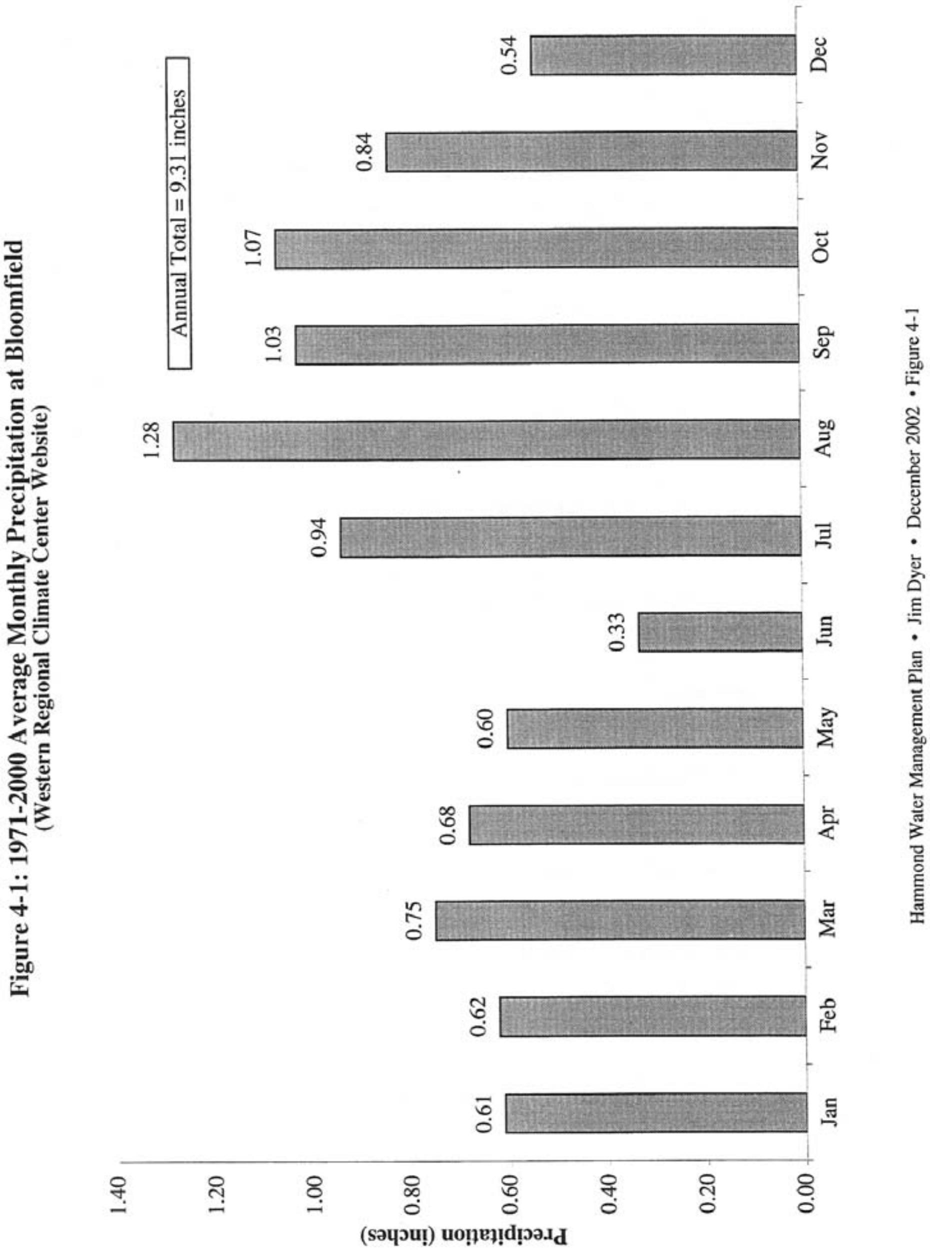


**Figure 10. Figure 4-2**

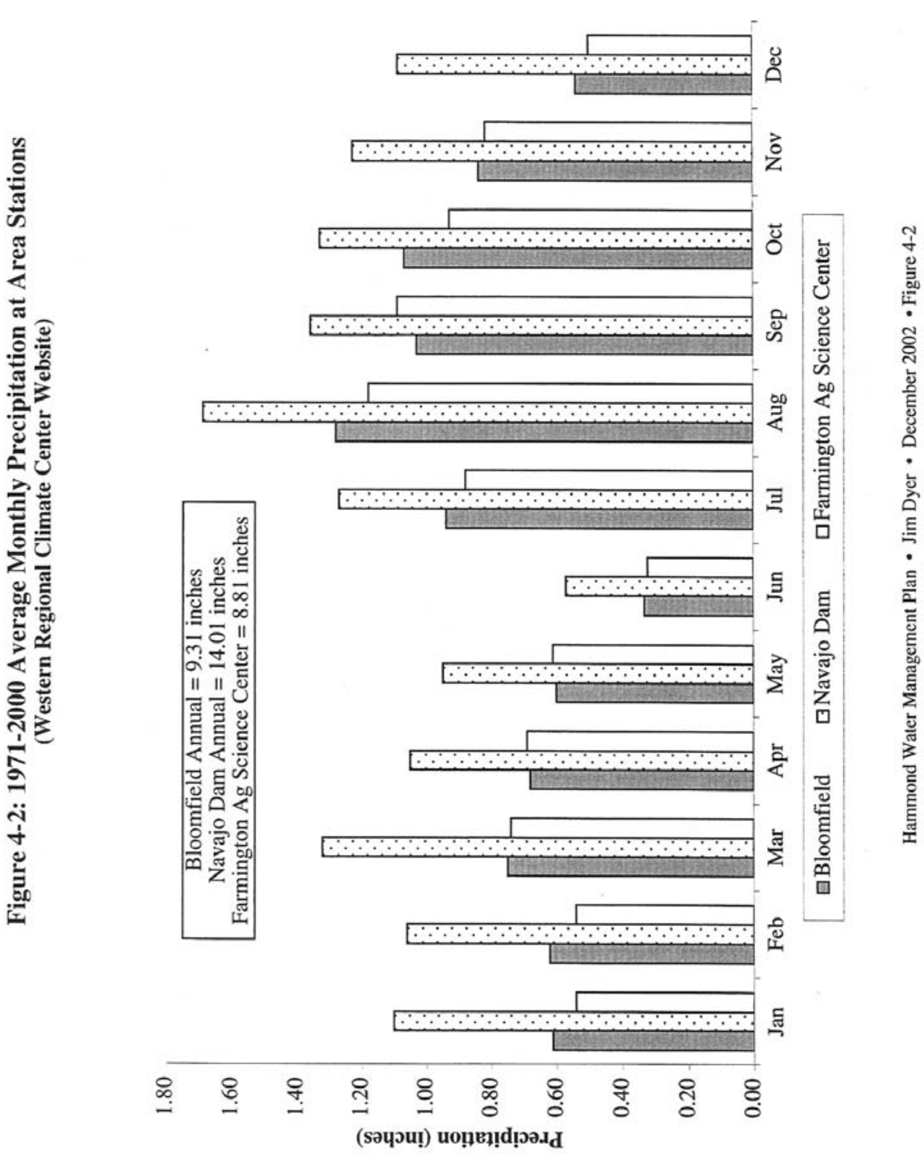


**Figure 11. Figure 4-3**

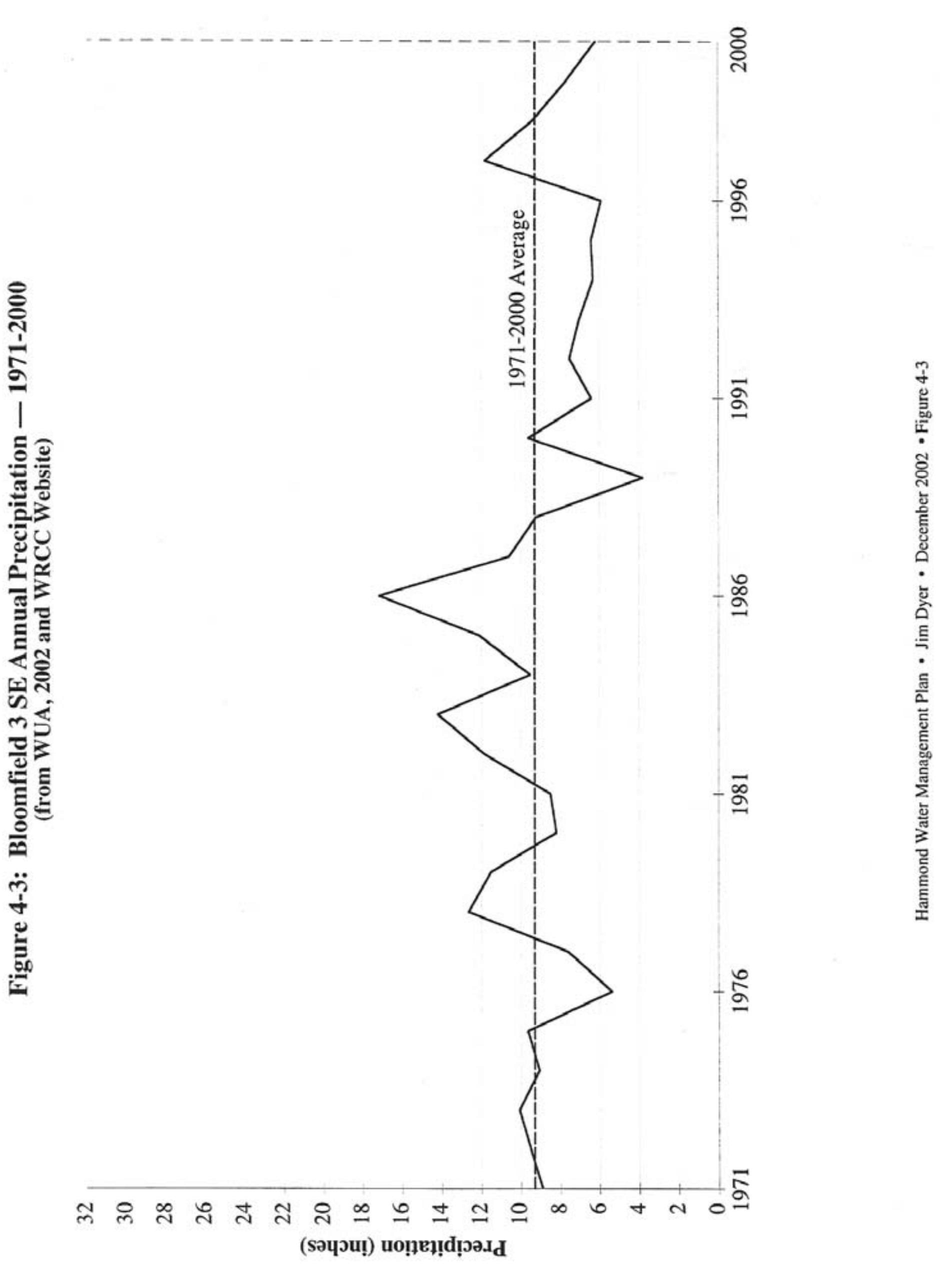


**Figure 12. Figure 4-4**

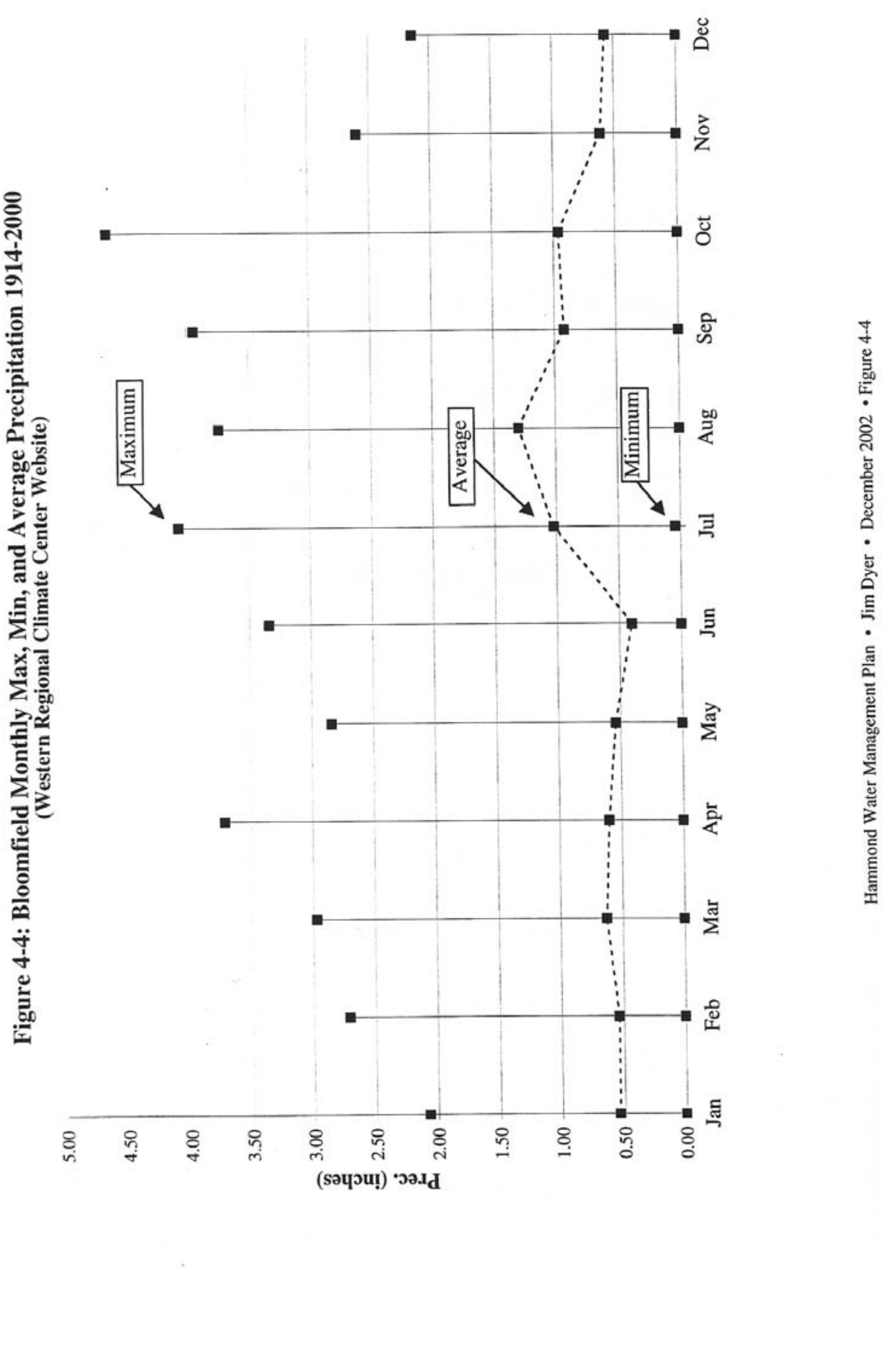


**Figure 13. Figure 4-5**

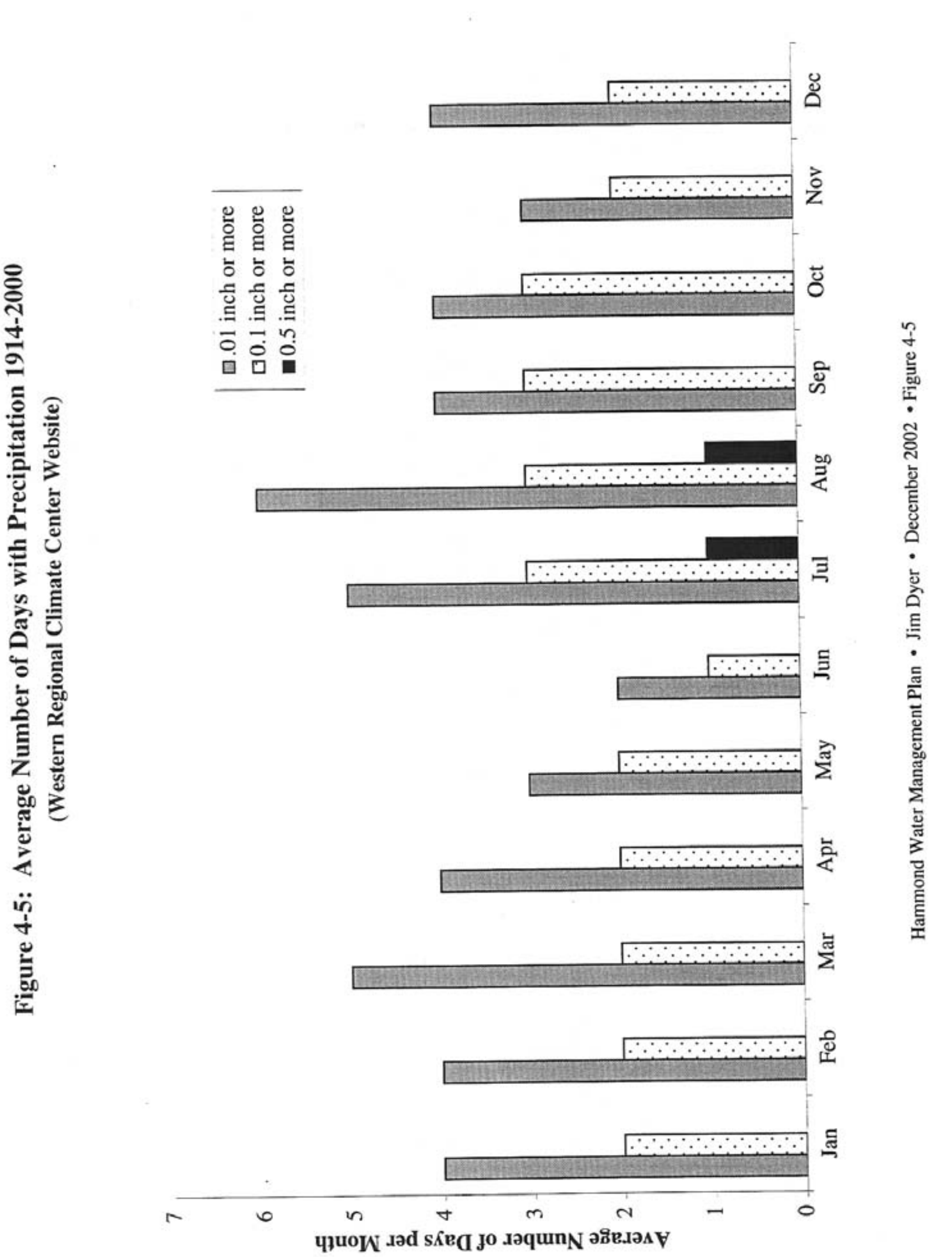


**Figure 14. Figure 4-6**

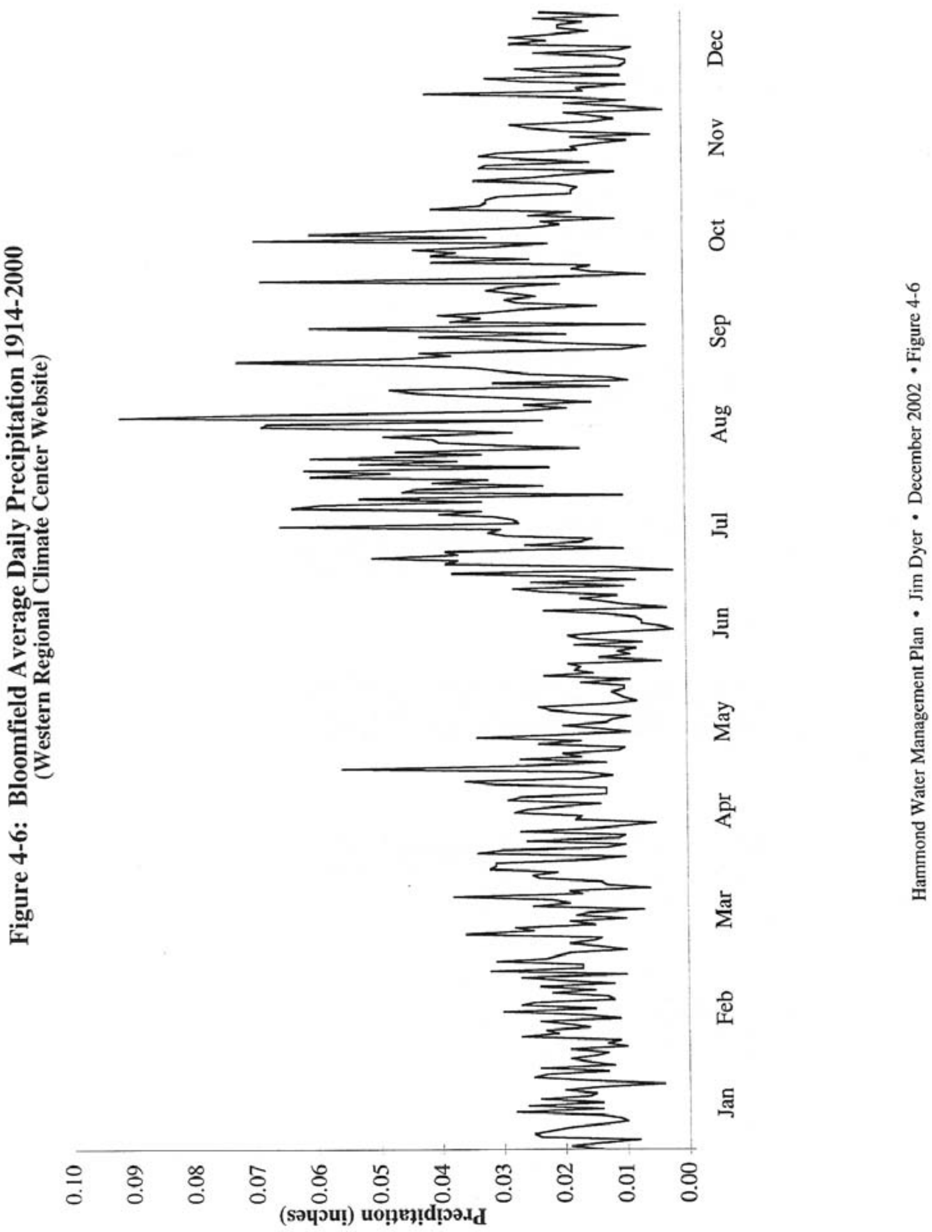


**Figure 15. Figure 4-7**

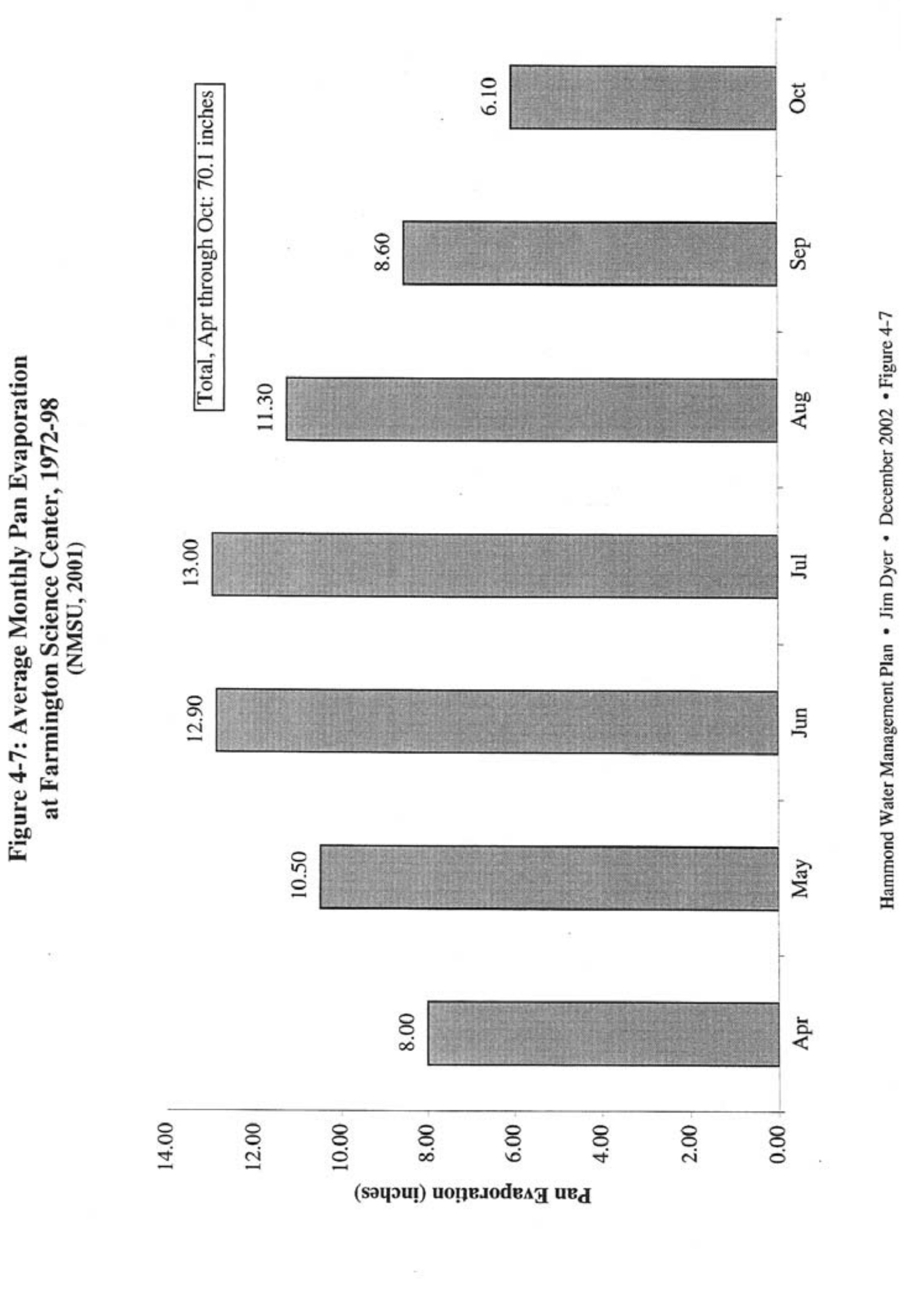


**Figure 16. Figure 4-8**

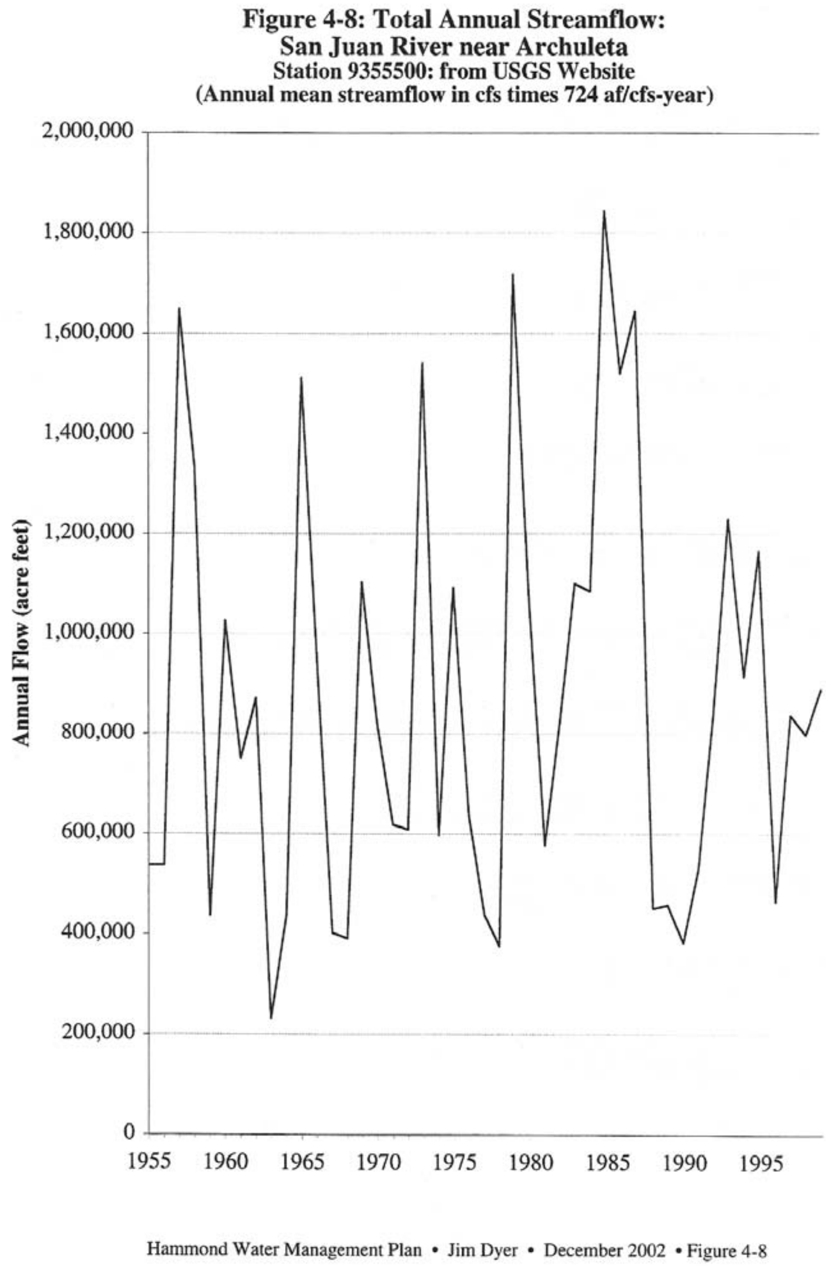


**Figure 17. Figure 4-9**

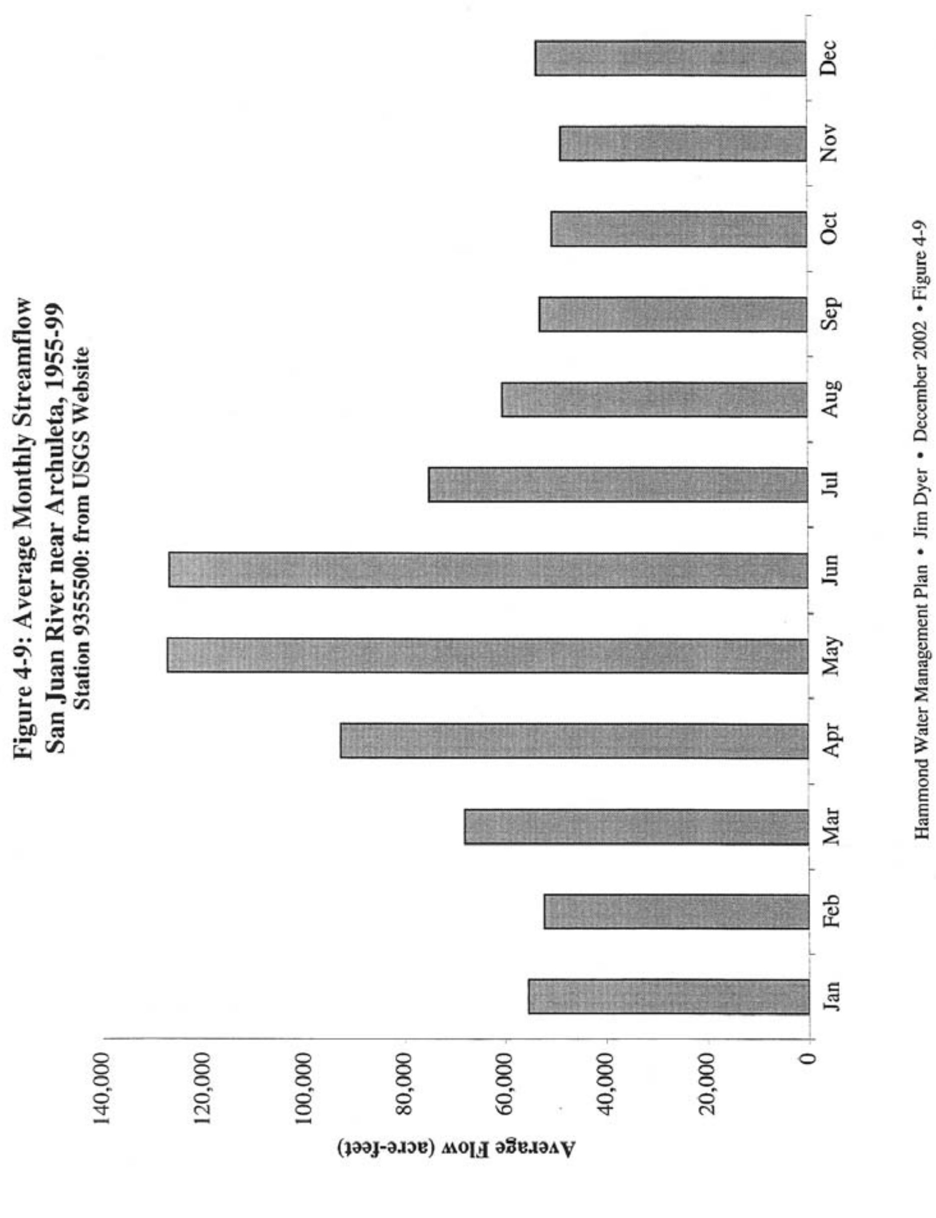


**Figure 18. Figure 4-10**

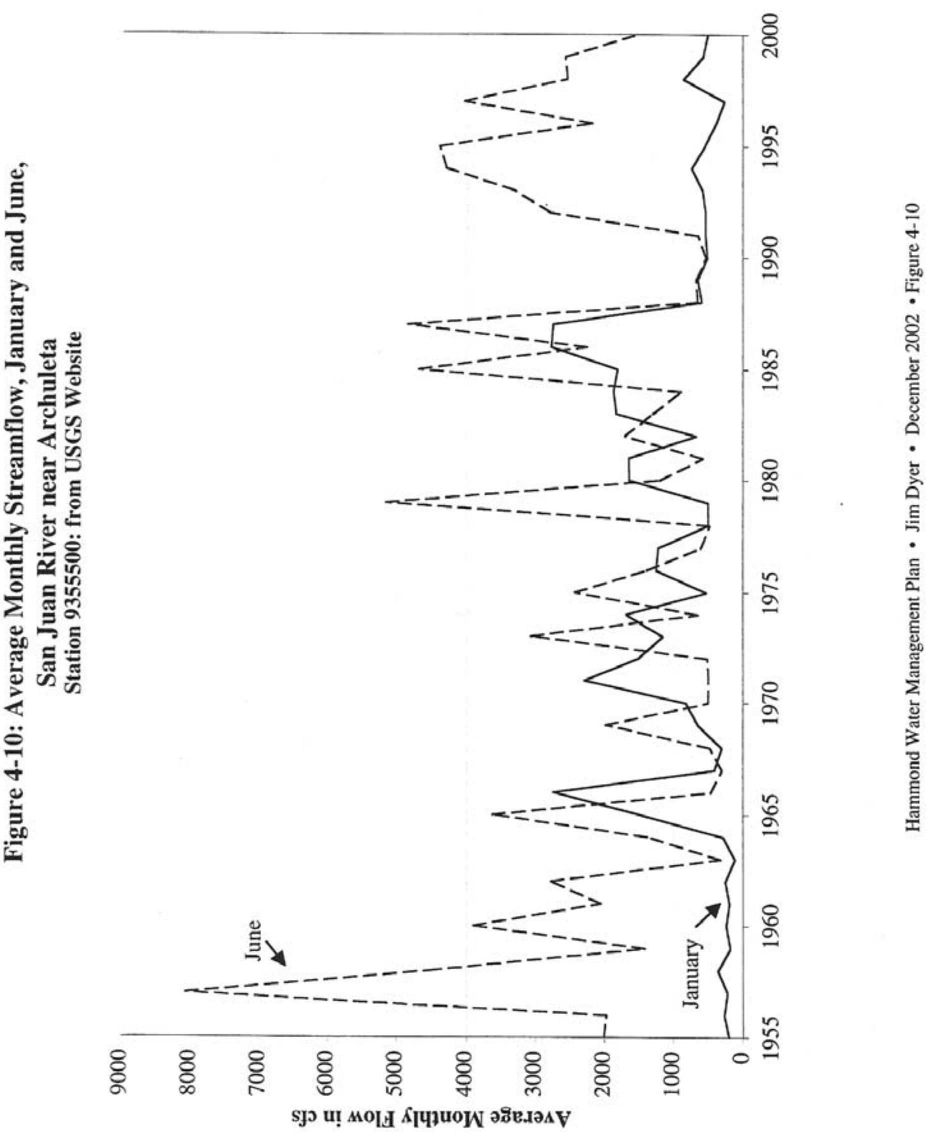
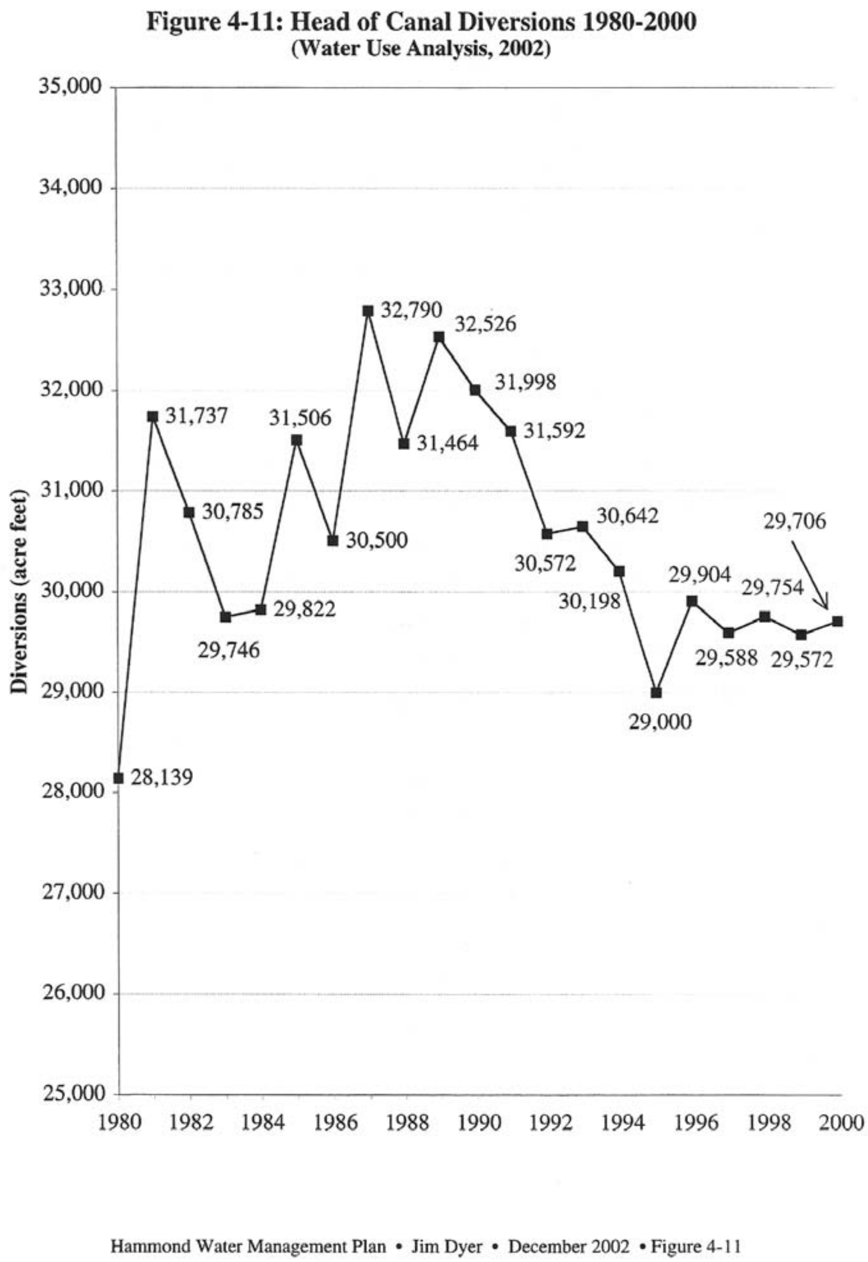


**Figure 19. Figure 4-11**



## 5.0 WATER BUDGETS — How is the District's water used?

In this section, the amount of water diverted will be compared to the uses to which it is put. As much as the data will allow, diversions will be broken down to show the comparison between supply and demand more clearly and to point out opportunities for improvement. The efficiency of various parts of the system will be estimated.

### 5.1 Overview of Efficiency Determinations

There are many different ways of considering how well water is used:

- The first consideration would be for what purposes — for what end uses should it be used. This might be called the appropriateness of water use, and it depends on the values, needs, and desires of those making the water use decisions.
- Secondly, once that is decided, determinations can be made of how well those end uses are achieved by the use of a given quantity of water — in other words, the bottom line — for providing safe and convenient water-related services in the home, for making a living in farming and ranching, for providing recreation opportunities, for extracting energy resources, etc. This might be called end-use efficiency.
- The third consideration is in comparing the water withdrawn (and other resources used, such as energy and labor) to the specific water benefits obtained — getting water to fields, flushing toilets, providing drinking water in homes. For this third purpose water use efficiency calculations are made.

This section will deal primarily with the various aspects of water use efficiency and then consider end-use efficiency in terms of comparing crop yields to the amount of irrigation water used to produce them.

AGRICULTURAL WATER USE EFFICIENCY: Agricultural water use efficiency analysis compares the amount of water diverted for irrigation to its uses. Efficiency is commonly calculated for specific parts of the system in order to isolate areas for improvement. Recall from Section 2:

$$\textbf{Water Use Efficiency} = \frac{\textbf{Benefit Gained from Water Used}}{\textbf{Amount of Water Used}}$$

Figure 5-1 shows that the overall irrigation water use efficiency is made up of two basic components: 1) how efficiently water is transported to the irrigators (conveyance efficiency), and 2) the on-farm efficiency — each of which are described in following sections. Figure 5-2 shows the specific components of the agricultural water budget.

## 5.2 Data Available for Measuring Efficiency

Fortunately, the Bureau of Reclamation has recently prepared the *Hammond Conservancy District Water Use Analysis* (USBR, 2002) which contains the data for calculating efficiencies of the Hammond system over the past 20 years. Most of the base data was derived from the Annual Crop and Water Reports prepared by the District.

BASIC WATER DATA: The basic water data from the Annual Reports consists of monthly values of the following as shown in Figure 5-3:

- **Diversions —** water diverted for irrigation at the "Head of Canal"
- **Operational Spills —** "water spilled through wasteways from canals and laterals" (with the data from the four spills shown in Figure 5-4)
- **Farm Deliveries —** total water delivered to irrigators
- **Transport Losses —** calculated evaporative and seepage losses from canals and laterals (no on-farm losses are included)

This last item, Transport Losses, is calculated from the relationship:

**Diversions = Operational Spills + Transport Losses + Farm Deliveries**

CROP WATER USE DATA: The *Water Use Analysis* lists areas of various crops grown in each year, 1980-2000 as depicted in Figure 3-6. From this and local weather data, the "(Crop) Consumptive Use," or the total amount of water needed by the crop, was calculated in the *Water Use Analysis*. This consumptive use requirement can be met by the sum of irrigation and precipitation. It is standard practice to assume that only a portion of the rain that falls actually gets to the crop — that portion which is termed the "Effective Precipitation." The remainder must be provided by irrigation and is called the "Net Consumptive Use" as follows:

**Net Consumptive Use = Consumptive Use - Effective Precipitation**

The relationships between these water values can be seen in Figure 5-5, where values are depicted over the 1980-2000 period.

### 5.3 Overall Efficiency

"Overall Efficiency" compares the total water diverted to the amount of irrigation the crop actually needs — the Net Consumptive Use. This composite value will reflect any losses from diversion point to the field as well as any runoff, deep percolation, or other losses in the field.

$$\textbf{Overall Irrigation Efficiency} = \frac{\textbf{Net Consumptive Use}}{\textbf{Diversions}}$$

Figure 5-6 shows the Overall Efficiencies over the 1980-2000 period with values ranging from 20% in 1982 to 39% in 2000. Two factors seem to have contributed to increased efficiency in 2000: the reduced seepage due to lining and the increase in acreage irrigated while diversions remained nearly constant.

### 5.4 Conveyance Efficiency

It is useful to isolate the losses before water gets to the farm turn-out since different means are employed to reduce those losses compared to on-farm losses. For this reason, "Conveyance Efficiency" is calculated giving a measure of the relative importance of the Transport Losses mentioned above. The value of determining conveyance efficiencies on an ongoing basis for various parts of the delivery system is that areas of high losses can be isolated and corrected, especially if the losses are hidden, and new leaks and losses can be found soon after they arise. The calculation is as follows:

$$\textbf{Agricultural Conveyance Efficiency} = \frac{\textbf{Farm Deliveries}}{\textbf{Diversions}}$$

Figure 5-7 shows the Conveyance Efficiencies for the 1980-2000 period. Values range from a low of 40% in 1994 to a high of 62% in 2000. It must be noted that this calculation includes the spills resulting from the operation of the hydraulic turbine, along with all other spills or "operational water."

### 5.5 Farm Water Use Efficiency

Calculating farm efficiency can help monitor the losses at the farm level — deep percolation in the field, ditch seepage and evaporation on the farm, field evaporation, and runoff. In this case, crop water needs are compared to water delivered to the farm. Farm Efficiencies calculated from WUA data for the Hammond District as a whole range, as seen in Figure 5-8, from 38% in 1982 to 70% in 1994.

$$\textbf{Farm Efficiency} = \frac{\textbf{Net Consumptive Use}}{\textbf{Farm Deliveries}}$$

It should be noted that individual farms and fields in fact will have different Farm Efficiencies depending on environmental conditions and irrigation practices, and that calculating these efficiencies can help farmers make better farm-level management decisions.

### 5.6 Agricultural Production Efficiency

As mentioned earlier in this section, even more fundamental than water use efficiency is the issue of end-use efficiency, ie., what is the return from, or result of a given amount of irrigation water. The returns may be measured in yields, gross revenue, or ultimately the net profit for the product being raised. Curiously, these kinds of “bottom-line” calculations that really determine the worth of irrigation water are all too rarely considered by irrigators.

The following comparisons are possible if data are available:

1. Crop Yield compared to Farm Deliveries
2. Crop Yield compared to Stream Diversions (for that cropping area)
3. Gross Revenues to Farm Deliveries
4. Gross Revenues to Stream Diversions (for that cropping area)
5. Net Farm Profit to Farm Deliveries
6. Net Farm Profit to Stream Diversions (for that cropping area)

For 1 and 2 above, improvements for any given crop can be achieved by combinations of better crop management, better variety selection, increased conveyance efficiencies (for 2), and better application efficiencies. For 3 and 4 above, additional increases are possible with higher yields, higher-valued crops, and higher market prices. For comparisons 5 and 6, increased “efficiency” would result from lower crop production costs in addition to all the improvements above.

As Dan Smeal of the Farmington Ag Science Center points out (personal communication, 24 April 2001), 48 inches of water (crop consumptive use) can ideally produce 8 tons per acre of alfalfa, while 27 inches has yielded 30 tons per acre of tomatoes at the Center. Dan’s rough estimates indicate that the same acres could yield a gross return of $21 per acre-inch of consumptive use from alfalfa, and $370 per acre-inch in the case of tomatoes. All that would be required to complete the analysis would be to include the production costs so that net profit per acre could be determined. Obviously crop choice is a big factor.

As Dan further suggests, this kind of analysis supports the premise that small acreages, on which higher valued crops are more commonly raised and perhaps more feasible, are no less important economically than larger parcels, on an acre by acre basis. For this reason, attention to irrigation practices and efficiencies on small parcels are an important part of this plan.

The Farmington Ag Science Center has conducted research to determine the best pasture grasses for this region for greatest yield per unit of water used (Smeal et al, undated manuscript), and alfalfa yields resulting from increasing amounts of water use (Smeal, et al, 1995).

### 5.7 Use of Monthly Data

It is obvious that the consumptive use of crops varies through the growing season, but attention to this is sometimes less prominent in irrigation scheduling than it should be. For this reason, it is useful to track crop water needs along with irrigation application rates on a monthly basis. Less obvious perhaps, is that the efficiency with which crops use water also can vary monthly through the growth period. Tracking of monthly water use (or for various cuttings of forage crops) may reveal strategies for dealing with limited irrigation supplies.

### 5.8 *Water Use Analysis* Findings

Mr. Chuck Jachens of the USBR prepared the *Hammond Conservancy Water Use Analysis* – finalized in March 2002 in an effort to determine the amount of water required to irrigate the 3933 acres entitled to project waters. By analysis of 20 years of crop, weather, diversion, farm delivery, and spill data, the USBR determined that, according to Bureau standards (74% non-exceedance criteria – see WUA report), the "full project water supply" for 3933 acres, and after canal lining, is 35,562 AF per year. The components of this supply are seen below (data from WUA 2002, Appendix 19, not the narrative pages — as advised by Chuck Jachens, personal communications, 16 April 2002)

**Table 5-1: Hammond Water Rights**

| | **Water (AF)** |
|---|---|
| Net Consumptive Use | 11,013 |
| Effective Precipitation | 1273 |
| On-Farm Losses | 8380 |
| Transport Losses | 1148 |
| Operational Spills | 13,748 |
| Full Supply Diversion Requirement | 35,562 |

The effect of canal lining is seen in the relatively low "transport losses" above. Mr. Jachens has pointed out the relatively high levels of operational spills. He indicated that operational spills of 10% of diversions can be achieved with relatively low automation of canal operations, and even as low as 3% with highly automated systems (Chuck Jachens, Hammond Public Meeting, 16 April 2002).

Some of this "spill" or "project operation water" at Hammond is due to the hydraulic turbine described earlier. Apparently, the turbine has not operated at its design capacity, increasing the spills required for its operation. That shortcoming aside, the turbine does reduce the cost and environmental consequences of conventional pumping. For this reason, it makes sense to consider spill volumes due to the turbine operation separately from the remainder of the spills. Bringing the turbine up to full efficiency, and automation to reduce the remaining spills are the two separate opportunities for the District to pursue.

**Figure 20. Figure 5-1**

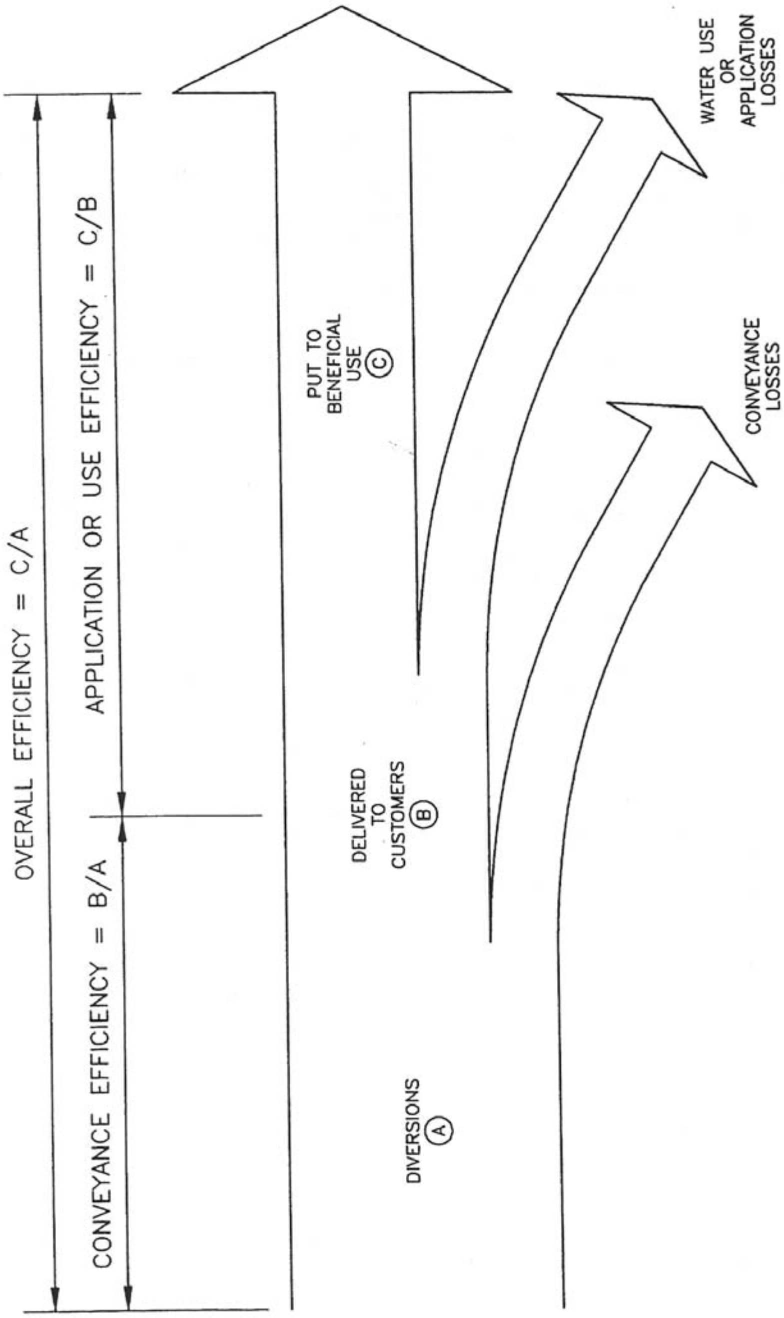



**Figure 5-1: Basic Efficiency Components**

**(from San Juan County Water Management and Conservation Plan, 1999, Wright Water Engineers, Inc.)**

Hammond Water Management Plan • Jim Dyer • December 2002 • Figure 5-1

**Figure 21. Figure 5-2**

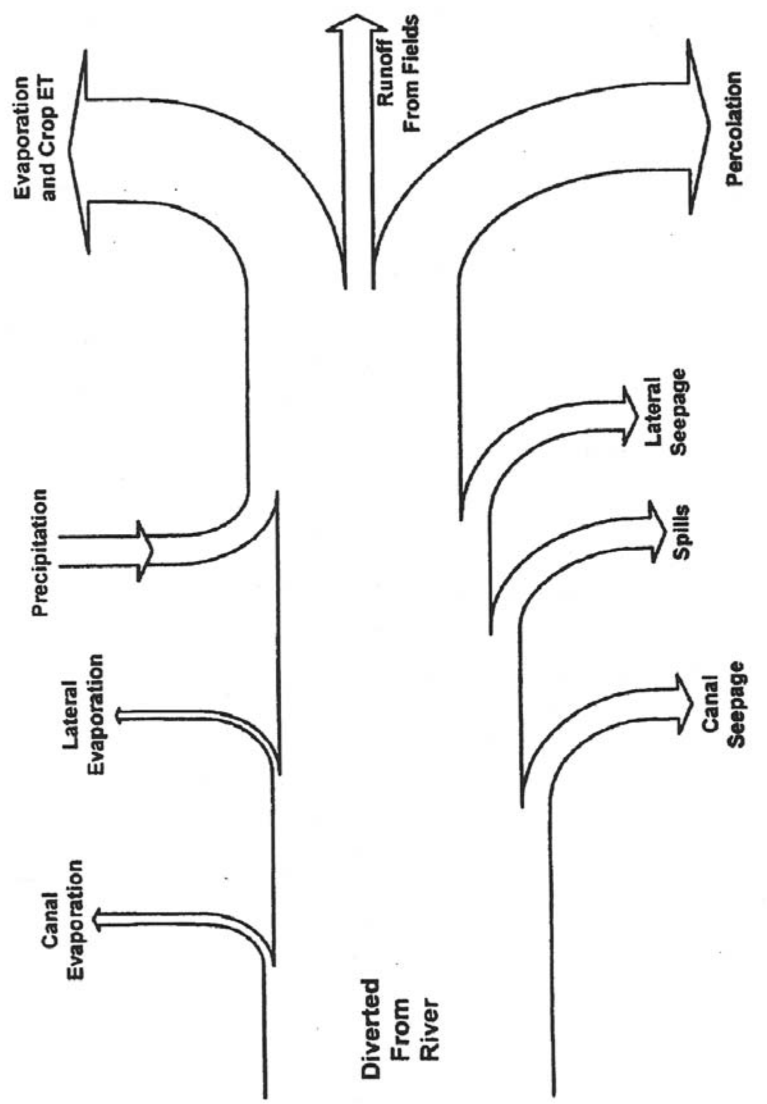



**Figure 5-2: Agricultural Efficiency Components**
**(from "Achieving Efficient Water Management", 2000, USBR)**

Hammond Water Management Plan • Jim Dyer • December 2002 • Figure 5-2

**Figure 22. Figure 5-3**

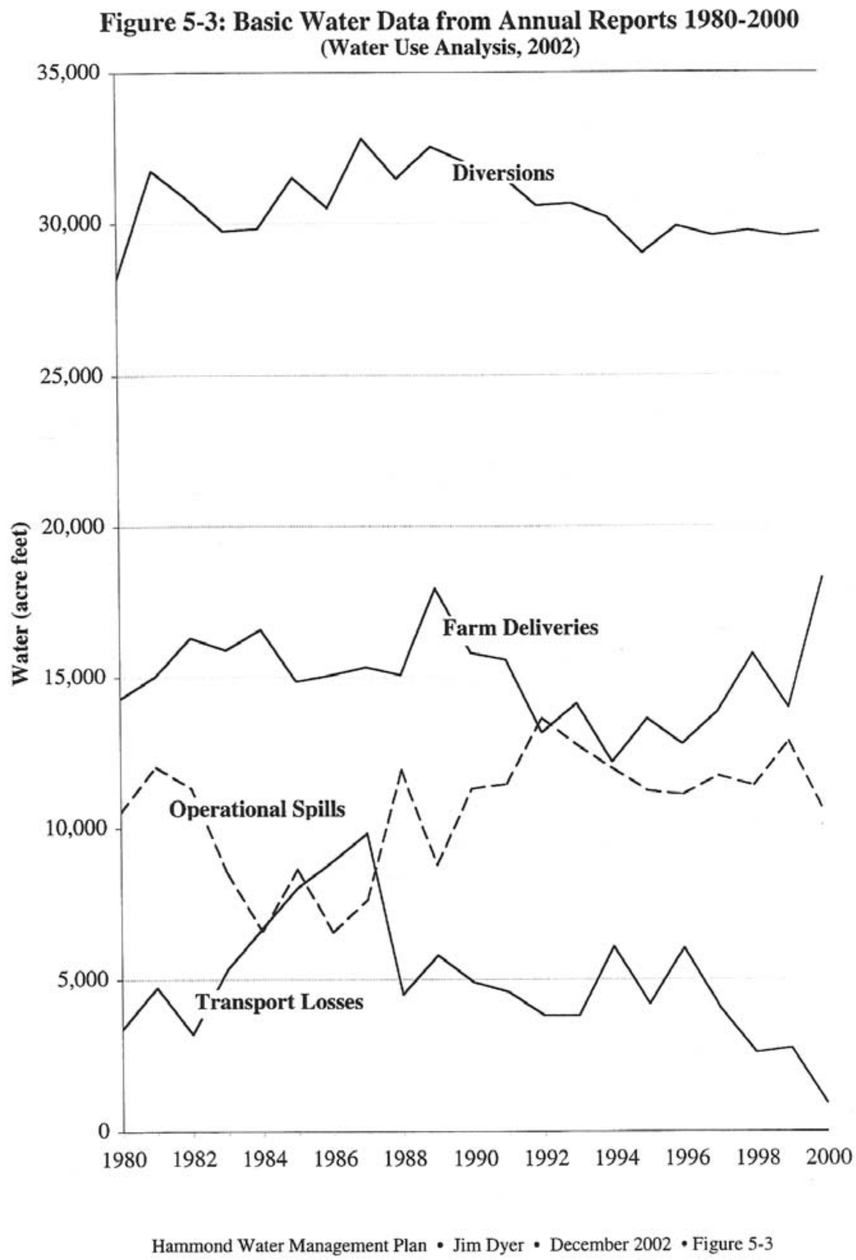


**Figure 23. Figure 5-4**

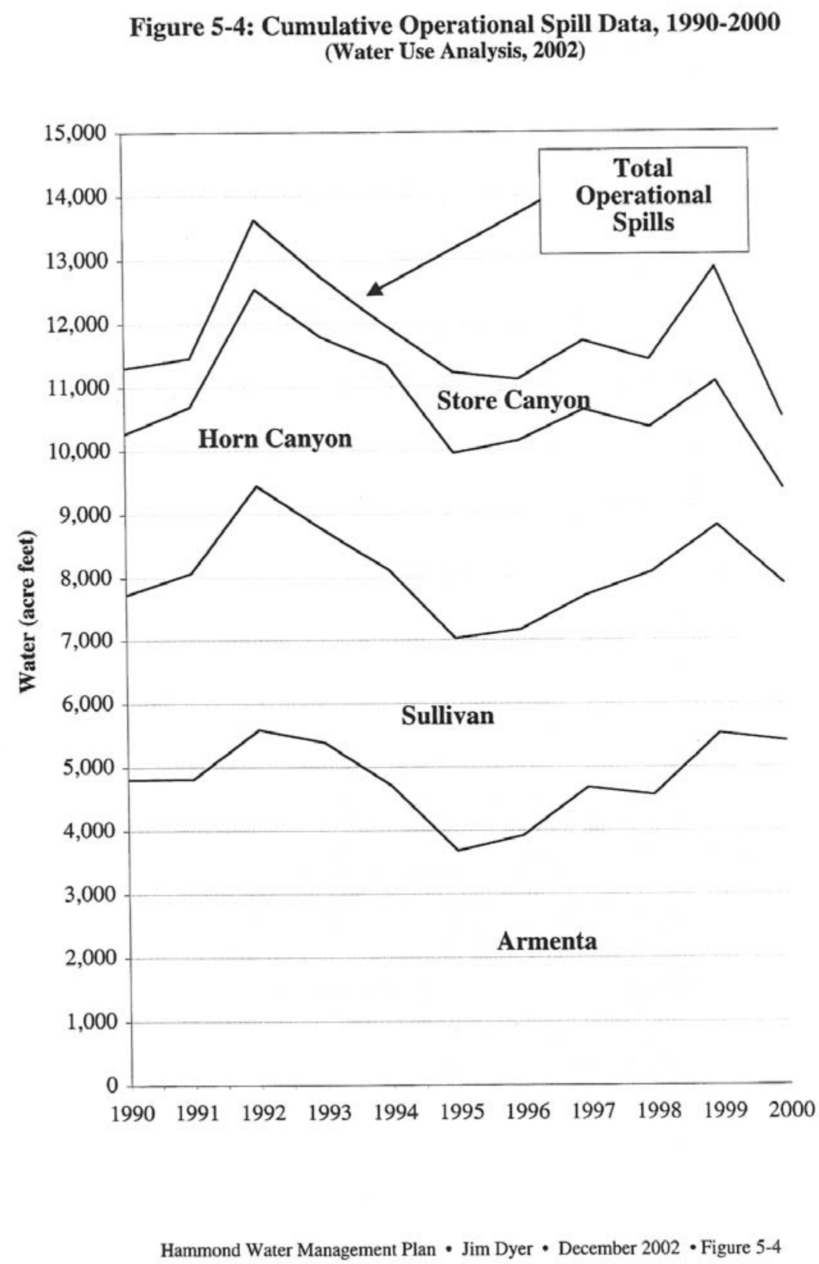


**Figure 24. Figure 5-5**

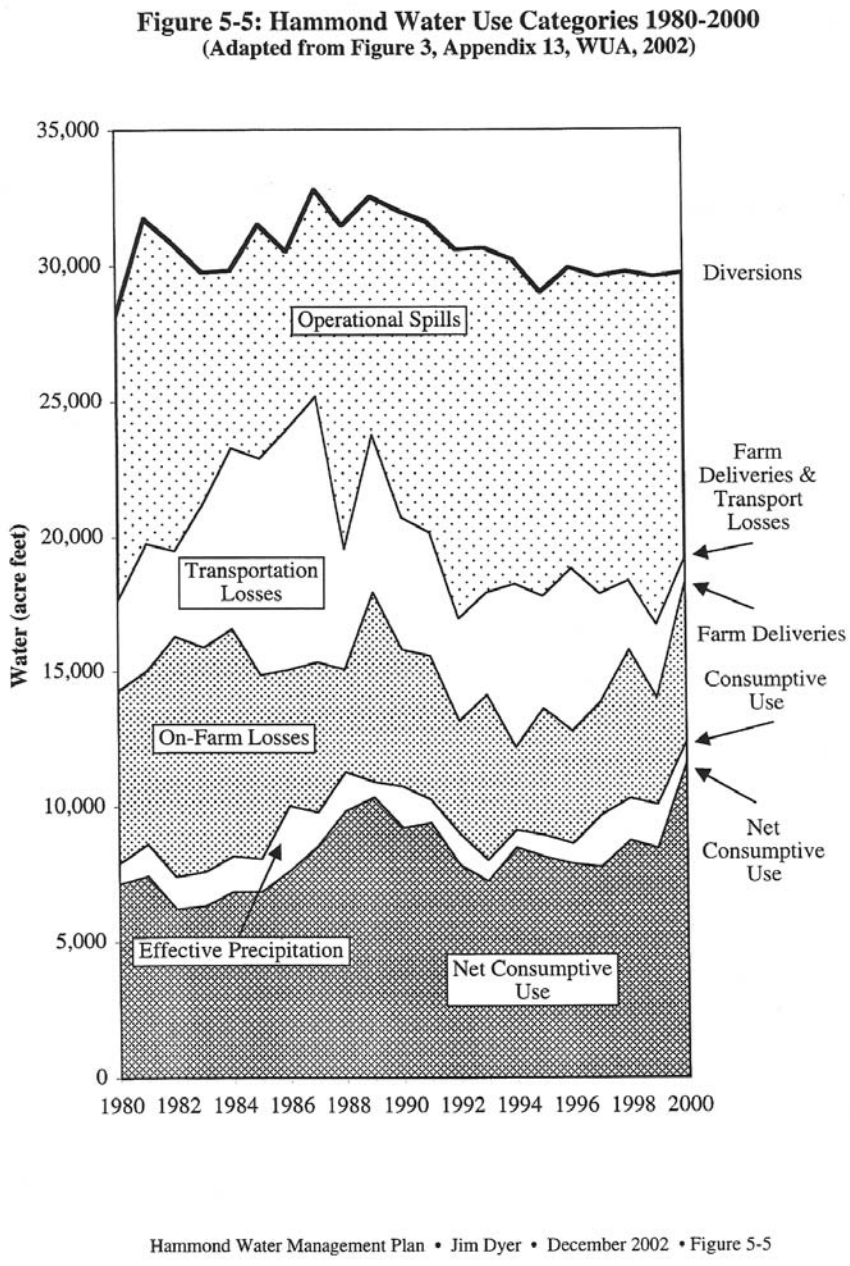


**Figure 25. Figure 5-6**

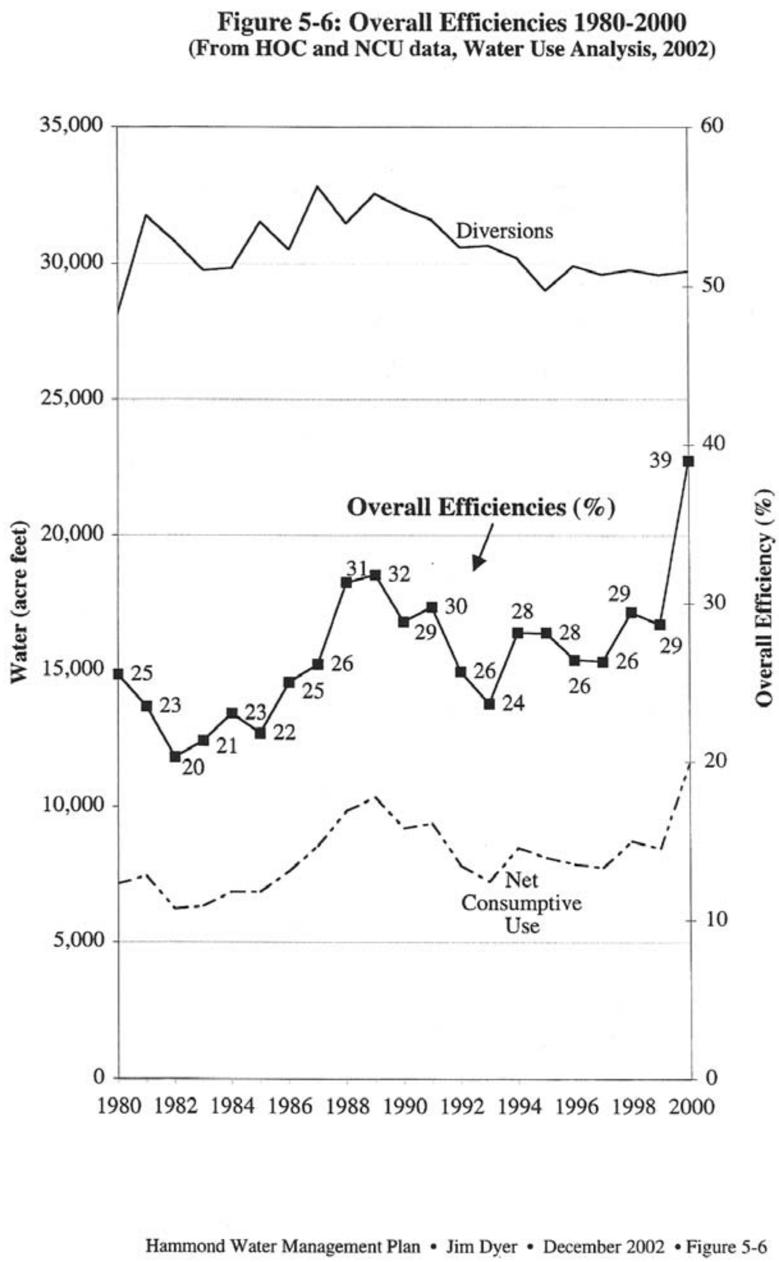
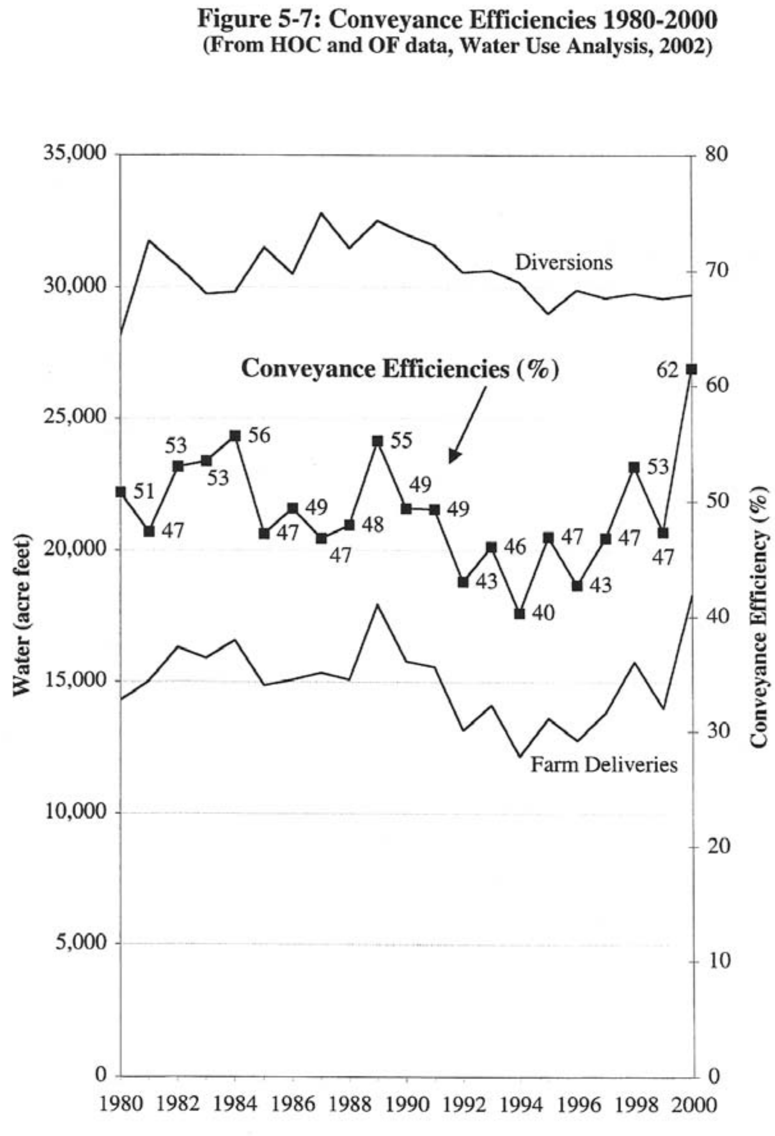
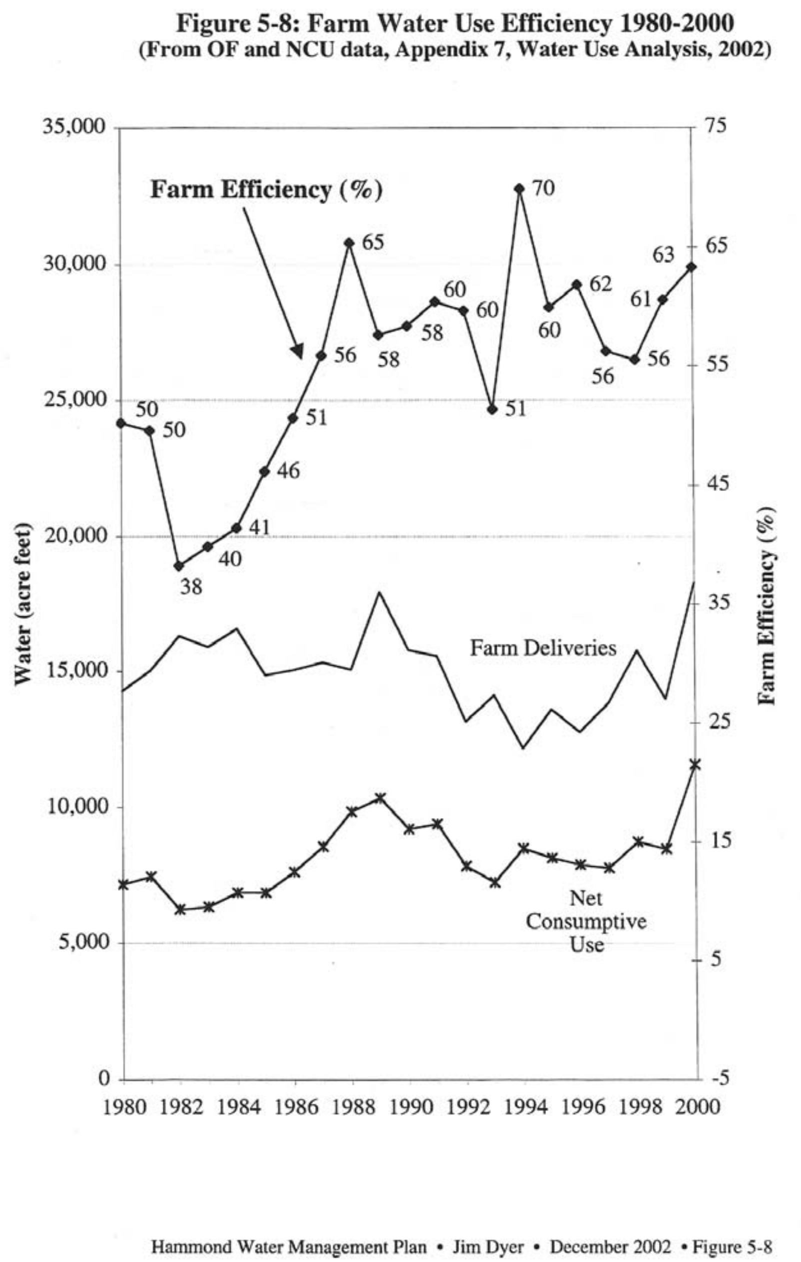


**Figure 26. Figure 5-7**




Hammond Water Management Plan • Jim Dyer • December 2002 • Figure 5-7

**Figure 27. Figure 5-8**



## 6.0 EXISTING WATER MANAGEMENT MEASURES — What efficiency-related management measures are in place now?

Before deciding on efficiency improvements, it is necessary to determine what management measures that support efficiency are now being used in the Hammond District.

The water users of the Hammond District are generally very reasonable in their use of water, but only a few measures are codified as policies or otherwise documented. Yet, as water demands increase, and as better documentation of water use becomes necessary, written policies will be more and more helpful. The following measures are mostly programmatic in nature, and are in addition to all the unnoticed daily efforts by Hammond irrigators to make the best use of their water.

### 6.1 Canal Lining

The Hammond District has greatly reduced unnecessary seepage losses through extensive concrete lining of the canals. Troublesome spots were lined in the 1960s, but the major lining was accomplished between 1997 and prior to the 2002 irrigation season (Teresa Lane, personal communication, 2002). This lining was supported by the USBR as a salinity control effort, based on an expected reduction in salt loading for the San Juan River from Hammond of 27,700 tons per year. The WUA report calculated that the average annual seepage was reduced by 4563 AF to 912 AF. (USBR, 2002) Figure 6-1 shows the 1980-2000 trend of “Transportation Losses” with a clear reduction resulting apparently from the lining project.

### 6.2 Efficient Application Techniques

Figure 6-2 shows the consistent increase in the area irrigated by sprinklers rather than flood techniques over the 1980-2000 period. The 96% level reached in 2000 is an impressive contribution to water use efficiency. Drip irrigation is increasing, but still rather uncommon in the Hammond District.

### 6.3 Water Pricing

The Water Management Bank, described in Section 3, does provide a means by which an irrigator may avoid the water charge for any water deposited in the Management Bank, and this should encourage efficient water use. This does present an efficiency incentive, but perhaps not as workable or direct as an incentive-based water rate might offer. In addition, only 6 irrigators leased water from the Bank in 2001, totaling less than 300 AF of water, and participation is limited by the need to keep total irrigated land at or below 3933 acres in any given year.

The current water pricing system, also described in Section 3, does not provide an incentive to use less than the annual duty of water allowed per acre. It should be noted that for many years prior to 1999, the “Water Charge” of $2.75 per acre-foot was assessed only on the water actually accepted by the irrigators, but that at present, irrigators are charged for the full duty of water whether used or not.

### 6.4 Education Programs

The Hammond District currently conducts an annual “Water Master School” to help those responsible for managing District water delivered to subdivisions. Irrigators and District staff also take advantage of regional workshops and trainings, especially the Four Corners Irrigation Workshops.

### 6.5 Water Measurement and Accounting

The preparation of the *Water Use Analysis* by USBR has provided the Hammond District with excellent trend data for the past 20 years of diversions, transport losses, consumptive use, and other fates of project water. In this respect, Hammond has an excellent baseline accounting of their water use, which should allow them to more easily detect problems and monitor improvements over time.

With USBR assistance, the District has progressed quite far in data gathering and automation improvements, with the most recent additions being dataloggers and remote-capable, real-time monitoring at the main spill locations:

- Armenta Canyon
- Sullivan Canyon
- Horn Canyon
- Store (or Stewart) Canyon

**Figure 28. Figure 6-1**

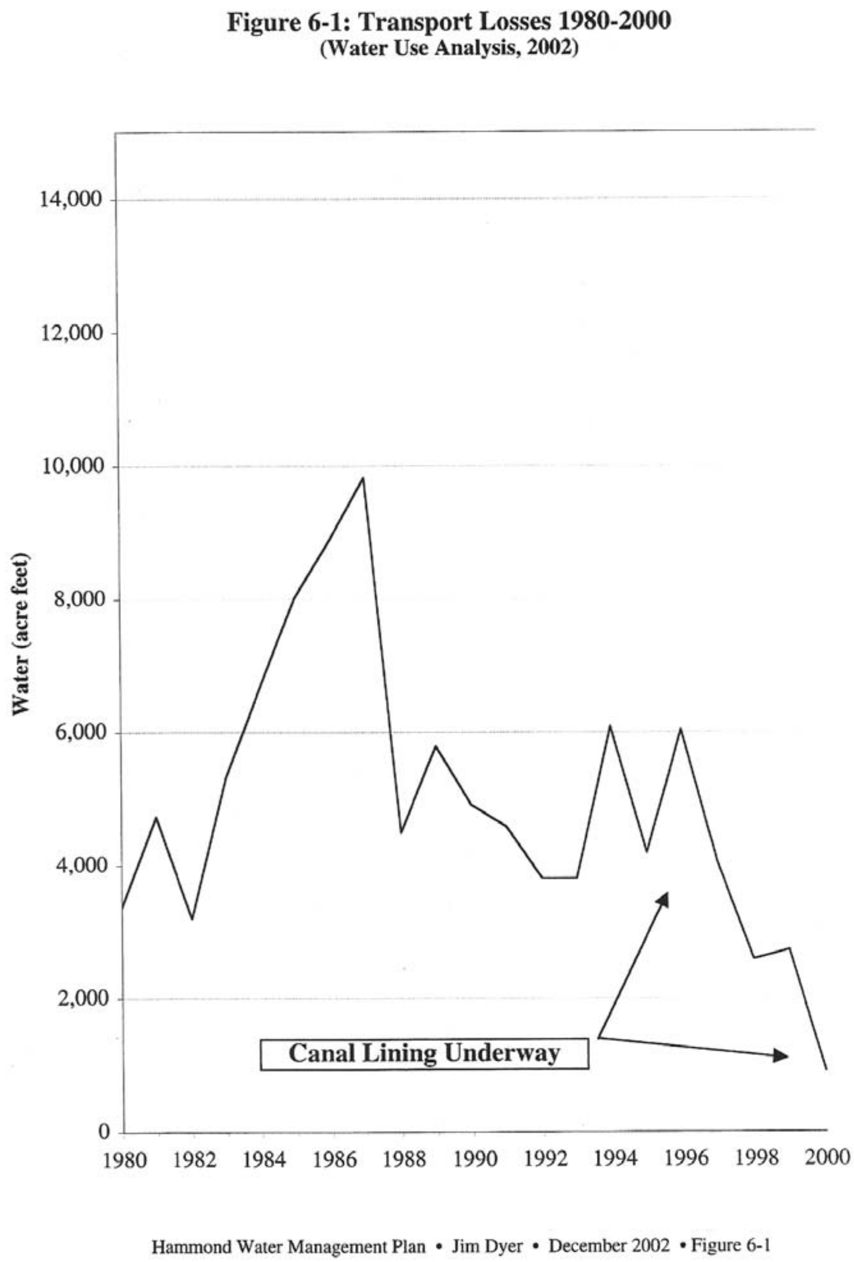
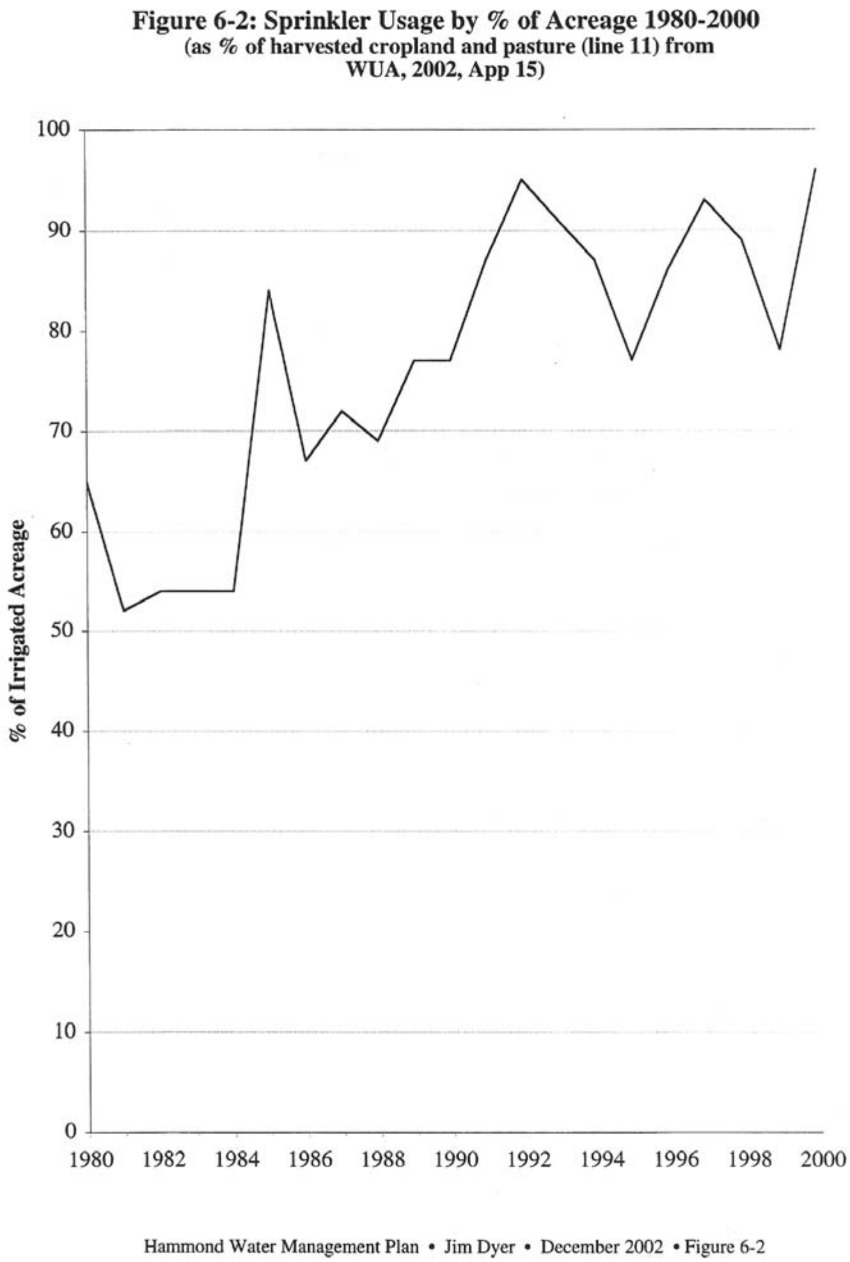


**Figure 29. Figure 6-2**



## 7.0 ISSUES AND GOALS — What does the District want to achieve?

This section will summarize the efficiency-related issues in the Hammond District and develop the water management goals to address those issues.

### 7.1 All Issues Raised

The Bureau of Reclamation "Guidebook" for preparing water management plans (Hydrosphere, 2000) calls for an exploration of the water management issues of concern to the District, irrigators, and other stakeholders. From a list of such issues — including problems, needs, opportunities, or concerns — goals are developed, and then actions or "measures" are planned to meet these goals. District staff, irrigators, and other stakeholders should be involved in this whole process. The following list of issues comes largely from the District's public meeting of 11 April 2001, and other communications from staff and irrigators. A transcript of issues recorded at the meeting can be found in Section 15. This list is not in order of priority.

**Issues relating to farm-level irrigation improvements:**

- Switching from sideroll to pivot application can save water, but corners may be lost.
- The Interstate Stream Commission (ISC) has low interest loans that may be able to help with switching to pivots.
- Improving on-farm efficiencies should be a goal — there are new more efficient sprinklers, and we have many small parcels.
- Education is needed both on crop management as well as irrigation water management in order to maximize the benefits of efficient water use.

**Issues relating to subdivisions and small parcels:**

- Urbanization of agricultural lands is affecting water use and management.

- Growth is causing more turnouts which complicates water management.
- A better policy is needed for turn-outs with multiple users.
- Education is needed for new irrigators.
- Can the pumping policy be improved?
- In subdivisions, does the District have any say once water leaves its ditch?
- Look into implementing a small tract policy.
- There are special opportunities for efficient water management on small parcels.

**Issues relating to unserviced lands:**

- Some Class A land is unserviced.
- Some of the unserviced lands are using water from the "water management bank."
- Contracts, instream flow regulations, and ESA restrictions should be reviewed in light of these unserviced lands.
- Water rights and permits should be reviewed also.
- Opportunities for moving water to unserviced lands should be explored.
- Can water be transferred permanently from parcel to parcel within the District?
- Look at the Bureau's re-allocation process.

**Issues related to canal management:**

- More efficient use of ditchriders should be considered — timing of deliveries, water measurement, and automation.
- Noxious weed plans will impact irrigation.
- The recent canal lining requires constructing new wetlands.
- Administrative changes on the San Juan River may adversely impact Hammond water management.

**Issues relating to water supply:**

- A non-consumptive water right for the hydraulic turbine pumping plant is desired by the District.
- Storage for Hammond for M& I and low-flow periods should be considered.
- When the releases from Navajo Reservoir are reduced to 250 cfs, will we have enough water?
- A water shortage plan should be developed.

**Issues related to District administration:**

- The water pricing structure should be reviewed.

**Issues related to preparation of this plan:**

- This plan should be compatible with SEO and ISC plans and with procedures on the Rio Grande.
- The annual crop report form should be reviewed to see if additional data is needed to improve water management.
- Keep all issues in the Water Management Plan.
- Include the history of Hammond and the early irrigators in this plan.
- Investigate how agencies use different methods for calculating consumptive use, resulting in different water use estimates.

**Comments received that relate to “Values and Guiding Principles”:**

- Understanding the history of the Hammond District is essential to proper water management decisions.
- We should maintain a strong agricultural base.

**Additional comments and suggestions received:**

- "Conservation Pool" is a better term for what the District now calls "water banking."
- It seems that there is no incentive for water conservation — it's use it or lose it.
- Land is taxed according to its water rights.

## 7.2 Key Issues

From the complete list above of issues raised by stakeholders the following set of "Key Issues" was selected. The issues selected were those which 1) appeared most important from the input received, 2) were most appropriate for consideration in a Water Management Plan, and 3) seemed most feasible to address effectively in this Water Management Plan. Many other related issues were folded into these key issues, and will be considered with them. The other comments received have been fully considered, and have been helpful in the preparation of this Plan. All issues that were raised have been included here so that those not selected as highest priorities at this time may be considered in the future. It should be noted that the issue relating to the non-consumptive water right for operation of the turbine was not selected as an action item since the District is already pursuing that option as a high priority.

A. On-farm efficiencies should be improved — there are new more efficient technologies, and there are many small parcels in the District for which special opportunities for efficient water management are available.

B. Education is needed both on crop management as well as irrigation water management in order to maximize the benefits of efficient water use.

C. Education is needed for new irrigators.

D. The water pricing structure should be reviewed.

E. More efficient use of ditchriders should be considered — timing of deliveries, water measurement, and automation.

F. A water shortage plan should be considered.

G. Opportunities for moving water to unserviced Class A lands should be explored.

### 7.3 Goals to Address Key Issues

The following goals are designed to address the issues under consideration in the Water Management Plan. Specific target dates for achieving goals are assigned where possible; in other cases, the District will consider implementing measures at a future date.

**Table 7-1: Goals To Address Key Issues**

| Key Issues | Goals |
|---|---|
| A. On-farm efficiencies should be improved — there are new more efficient technologies, and there are many small parcels in the District for which special opportunities for efficient water management are available. | 1. Complete an assessment by Fall 2005 of the farm-level irrigation technologies being used in the District on both small and large parcels.<br><br>2. By Summer 2004, ensure that irrigators are aware of the best irrigation improvements available, and of how to obtain technical and financial assistance for adopting them. |
| B. Education is needed both on crop management as well as irrigation water management in order to maximize the benefits of efficient water use. | 3. Initiate "in-service" training for District irrigators on the latest in irrigation water management and best irrigated crop management practices by Summer 2004. |
| C. Education is needed for new irrigators. | 4. By Spring 2004, provide introductory training in District procedures and efficient irrigation practices for irrigators new to the District in the past few years, and institute an orientation program for new irrigators as they arrive. |
| D. The water pricing structure should be reviewed. | 5. Consider, by Spring 2004, changes necessary to ensure that the District's water pricing structure provides incentives for efficient water use, meets the District's revenue needs, and is clear and equitable. |
| E. More efficient use of ditchriders should be considered — timing of deliveries, water measurement, and automation. | 6. Consider, by Fall 2004, any needed changes in operational procedures to ensure that water deliveries are timely and make the most efficient use of water, and that data collection is effective and an efficient use of the staff's time. |
| F. A water shortage plan should be considered. | 7. Develop a plan to cope with any foreseeable water shortages. |
| G. Opportunities for moving water to unserviced Class A lands should be explored. | 8. Ensure that water allocated to lands which can no longer be irrigated is reallocated to irrigable Class A land as soon as possible. |

## 8.0 POTENTIAL WATER MANAGEMENT MEASURES — What could be done?

This section will provide an overview of the wide range of management measures available to meet efficiency goals. From these, measures will be selected in the next section that are most feasible in meeting the particular goals of the Hammond District. First, measures common to all water sectors will be discussed followed by specifically agricultural measures.

### 8.1 Overview of Water Management Measures

As Table 8-1 indicates below, there are at least three different aspects of efficiency improvements. Technologies often receive the greatest attention since they are tangible, but the ways in which these new technologies are used, as well as new, wiser ways of using existing technologies is just as critical or more so. The water-saving potential of new tools or techniques are often quite promising, but until a method of putting them into use — an implementation program — is underway, no water will be saved.

**Table 8-1: Aspects of Efficiency Improvements**

| | **Household Example** | **Agricultural Example** |
|---|---|---|
| A technology | Water-efficient faucet | Efficient sprinklers |
| A habit or management technique | Turning water off while shaving | Efficient irrigation scheduling |
| An implementation program | Rebate provided by utility | Technical assistance provided by NRCS |

As indicated in the introduction, true efficiency improvements should not result in deprivation or hardship, but a job done as well or better with less water. Curtailment techniques such as fallowing land, selling off livestock, and rationing of water should be reserved for the true supply emergency.

### 8.2 Efficiency Measures Common to All Sectors

Proper **water measurement and accounting** systems are critical in all sectors for determining the baseline water uses and for monitoring progress of efficiency improvements. Without knowing the details of how much water is used for what purposes and when that use occurs, progress will be unclear, trouble spots will remain hidden, and responsibility for improvements will be hard to specify. An effective measurement system would consist of accurate measuring devices read accurately (using the Bureau of Reclamation's *Water Measurement Manual* (USBR, 1997) as a guide), and placed at delivery points to individual customers, as well as all other diversion, spill, and drainage points in the system. Frequent readings will allow real-time adjustments in management to be made and will serve the accounting system's tracking of all diversions, conveyance losses, individual customer usage, and spills.

**Incentive-based water pricing** structures — in other words, ones that encourage efficient water use — are an important aspect of progressive water management. Reduced rates for bigger water users (decreasing block rates) create a disincentive for saving water, and fixed charges provide no "price signals" to reward water savers. Incentive-based or conservation pricing schemes may combine several techniques — flat rates, increasing block rates, seasonal rates, a low minimum-needs rate — in a variety of ways to cover the provider's fixed costs, their cost of providing increasing volumes of water, costs of meeting peak demands, and the costs of developing new water sources. All these rate structures require careful planning to meet efficiency goals while maintaining fiscal viability. Guidance is available from the Bureau of Reclamation's *Incentive Pricing Handbook for Agricultural Water Districts,* (Hydrosphere, 1997).

**Education** is seen by most to be the most enduring and fundamental tool in promoting the efficient use of water resources. The more that water users know about the impacts of their water use choices — on their yields , their environment, and their bank account — the more their efficiency will increase. Measurement of results of such programs is difficult in quantitative terms, but this should not be a deterrent. Workshops, tours, bill stuffers, free publications, media programs, and newspaper columns can be effective vehicles for educating water users on efficiency topics. Demonstrations of technologies and techniques are especially influential in agricultural settings.

**Coordination** is especially key today to the efficient pursuit of efficiency. Various branches of federal, state, and local governments are requiring management plans and programs. In many cases, coordination of these activities will avoid unnecessary duplication of effort, and often will uncover opportunities for greater savings through cooperation. Water providers, management entities, and governmental bodies overseeing water management in any way should have a designated individual for water efficiency — to allow better communication and cooperative effort in water management.

### 8.3 Agricultural Efficiency Measures

**Canal lining and piping** can greatly reduce seepage and evaporation losses either in conveyance to the farm or on the farm itself. Seepage losses from unlined canals can exceed 50%, but lining can readily reduce that loss to under 10%. Piping can further reduce loss by eliminating evaporation and have the added benefit of providing pressurized water if needed. Accurate metering at appropriate locations can indicate the conveyance losses that these measures will reduce.

**Water reuse** in agriculture can include the use of municipal wastewater for irrigating land, especially pasture and forage, in ways that meet public health laws. In addition, the practice includes the "recycling" of tailwater by pumping it back to the fields for immediate reuse or into a storage reservoir for later use. Obviously, this would depend on whether a lower farm is utilizing the tailwater already, and whether the timing is right for putting the tailwater to use.

**Improved scheduling and soil moisture monitoring** is the centerpiece of most on-farm irrigation improvement programs. The amount of water a crop needs is best determined, not by when it is available, but by the stage of growth, the season's weather, soil conditions, crop type, and application methods. By recognizing the changing needs of the crop through the growing season, and monitoring the moisture content of the soil, a farmer can much better match crop needs to water application. Sophisticated real-time weather information systems and soil moisture measuring instruments such as tensiometers and atmometers are available, but the most cost-effective improvements can be captured first by relatively simple observations of soil moisture content and adjusting applications as needed. Simple hand probes are sometimes available from the NRCS for this purpose. Education and demonstration programs are essential for explaining the soil concepts necessary for an irrigator to turn a soil moisture observation into an updated irrigation schedule.

**Application efficiency improvements** can best start with choosing the most effective basic method of application. Gated pipe is generally considered to be 10 to 30% more efficient than flood application. Conversion from flood to sprinkler application can improve the application efficiency greatly — 30 to 50% above flood efficiency rates — if conditions permit. (Dan Lynn, La Plata NRCS, personal communication, February 2000). For existing sprinkler systems, low pressure drop nozzles or simply replacing worn nozzles can bring significant savings. Education and demonstration are again the key ways to gain acceptance of these improvements by illustrating the potential water savings, labor implications, and crop yield increases that may result.

**Delivery scheduling improvements** are often one of the most fundamental aspects of an efficiency program, but sometimes the most difficult to achieve. Since irrigators are urged to vary their application rates and timing due to their changing crop needs and soil moisture content, it makes sense to make deliveries as flexible as possible. Usually the simplest delivery scheme is to deliver a set amount of water at a predetermined schedule, and may even be as simple as providing all water that can be diverted until it runs out. In an ideal system, water would be ordered in the amount needed, when needed, and on short notice due to changing conditions. The financial, legal, and logistical constraints must be evaluated to determine how close to the ideal that the system can become.

**Conjunctive use** refers to using surface water and groundwater in a coordinated fashion to best meet the irrigation needs of a district. Given favorable geologic, hydrologic, and legal circumstances, a conjunctive use system might well use groundwater when surface water is not available and recharge the aquifer when excess surface water is at hand. While the cost of injection wells, constructed recharge basins, etc., may be high, the ability to achieve a supply more reliable and responsive to changing needs may make such systems cost-effective. Coordination between agricultural and municipal and industrial users may be useful as well.

## 9.0 SUGGESTED MEASURES — What improvements have been suggested?

In this section, a variety of measures, or options, that have been suggested by the District staff, irrigators, and the author to address the goals of the Hammond District are presented. These options are evaluated in the next section.

**9.1 Goal 1 — Technology Assessment:** Complete an assessment by Fall 2005 of the farm-level irrigation technologies being used in the District on both small and large parcels.

RATIONALE: Input from District irrigators indicated that:

- There are real opportunities for improved irrigation efficiency.
- There are new irrigation technologies that could be used.
- The abundance of smaller irrigated parcels calls for looking into what efficient technologies may be best suited to these parcels.

Without a good knowledge of what technologies are currently in use in the Hammond District, it is hard to know exactly what improvements are needed. At present only the number of acres under sprinkler and drip irrigation is included in the annual crop reports. Obtaining good baseline data on the current state could also allow the District to monitor and evaluate progress toward an improved state.

**Option 1 — Irrigation Technology Survey**: A survey could be conducted to determine the irrigation application equipment being used at present on each parcel in the District. Due to the potential for improvements on small parcels, all parcels could be surveyed. The survey could include:

- The type of technology (eg. sideroll, drip, gun, emitter type, nozzle type, etc.).
- Its age and state of repair (to the extent possible).
- The relative amount of leakage.
- The crops and area of land served.

- Other pertinent data.

The survey could be accomplished in three steps:

- A mailing could make all irrigators aware of the voluntary survey and request that they mail back their information.
- District staff could contact those who did not mail in their survey data, and ask if they could arrange a farm visit to gather the data. Visits could be conducted by staff or students or others hired by the District, who could be introduced to the irrigators before beginning the survey visits.
- Free irrigation consultations (sometimes called audits) by irrigation specialists could be offered to irrigators during which the data could be gathered. (see Option 2C).

Depending on how many surveys are accomplished by mail, most of the irrigators could be surveyed in 2 to 3 years. The District could consider how to incorporate data on changes in irrigators' technologies into annual crop and water reports, so that data could remain current.

**9.2 Goal 2 — Irrigation Technology Outreach:** By Summer 2004, ensure that irrigators are aware of the best irrigation improvements available, and of how to obtain technical and financial assistance for adopting them.

RATIONALE: Once the state of the irrigation technologies is known, irrigation technology experts in the region can be consulted to determine what technological improvements are most feasible for improved water application in the District. Better application technologies can provide more uniform and controlled application rates and less waste which can improve crop yields, reduce runoff and deep percolation problems, and reduce water waste. The brochure option could ensure that all irrigators know of their options, while the workshop, tour, and consultation options could provide much more detailed guidance for a smaller number of irrigators in selecting the best technologies for their particular situations.

**Option 2A — Irrigation Technology Brochure**: The District could consult with local irrigation specialists including Extension, NRCS, USBR, the NMSU Ag Science Center, and others to review the Irrigation Technologies Survey data and identify the most feasible and productive improvements appropriate for the District's irrigators. Special attention could be given to systems best for small parcels that are becoming more common in the District. Improvements could consist of:

- New application systems (such as drip irrigation for example).
- Renovations of existing systems (such as new types of sprinkler nozzles).
- Maintenance (such as replacement of worn sprinkler nozzles).
- Leak repair and reduction technologies (gaskets, etc.).
- Soil moisture sensing equipment.

A brochure could be produced describing the selected available technologies, sources of technical assistance, and possible sources of financial assistance. This brochure could be distributed to each irrigator in the District.

**Option 2B — Irrigation Technologies Training:** In addition to the brochure, the District could sponsor workshops and tours to provide interested irrigators with more in-depth exposure to the technological options available to them. Local specialists from Extension, NRCS, USBR, and NMSU could conduct the workshops which could include tours to see examples of the new technologies on farms in the District and perhaps at the NMSU Ag Science Center.

**Option 2C — Irrigation Consultation Visits:** The District could seek funding or in-kind assistance from USBR, NRCS, Extension, and other groups in order to offer free consultation visits by irrigation specialists to evaluate the technologies, scheduling, and crop management techniques used by irrigators, and suggest any needed improvements.

Sometimes called “audits,” these visits could be voluntary, and could help meet the objectives of the “Technology Assessment” and “In-Service Training” options.

**9.3 Goal 3 — In-Service Training:** Initiate “in-service” training for District irrigators on the latest in irrigation water management and best irrigated crop management practices by Summer 2004.

RATIONALE: Just as important, or perhaps more important, as having the best available irrigation technologies is for irrigators to have the latest information on how to best manage irrigation water supplies. Closely related, but often overlooked is information on best crop management practices for optimum utilization of irrigation supplies and for achieving the best crop yields.

**Option 3 — In-Service Training Workshops and Tours**: These training opportunities could be similar to the Technologies Workshop/Tours, relying on local NRCS, Extension, NMSU, and other specialists using a combination of workshops and tours to accomplish the training. Topics could include:

- Irrigation scheduling.
- Soil moisture determinations.
- Appropriate crop and variety selection.
- Crop management for optimum water use and yield.
- Pasture and grazing management for efficient water use.

Rather than presenting a textbook approach to all possible management options, the District could work with presenters to address the most appropriate and feasible options specifically suited to the Hammond District.

In addition to District-sponsored workshops, the following measures could be used for additional in-service training:

- Personalized, on-farm training could occur during the “Irrigation Consultation Visits” under Option 2C.
- The District could actively publicize the annual “Four Corners Irrigation Workshop,” and the Farmington Ag Science Center’s “Open House” functions.
- The District could encourage attendance at its “Water Master School” each season.
- The District could sponsor the appropriate staff attendance at outside workshops related to O & M procedures.
- The District could consider sources of funds to support the attendance at area workshops by District irrigators in the future.

**9.4 Goal 4 — New Irrigator Training:** By Spring 2004, provide introductory training in District procedures and efficient irrigation practices for irrigators new to the District in the past few years, and institute an orientation program for new irrigators as they arrive.

RATIONALE: Several of the issues raised by District irrigators relate to the inexperience, either real or perceived, of new landowners in using their water in the Hammond District. This inexperience may stem from being unfamiliar with the specific conditions and procedures of Hammond, and perhaps a lack of experience in irrigation in general. Since many of the new irrigators have smaller areas to irrigate, better knowledge may address some of the issues raised about these small parcels. To allow better use of Hammond irrigation supplies, and to reduce any disagreements that may arise with new landowners, a proactive orientation process is suggested.

**Option 4 — New Irrigator Orientation Sessions**: The District could require that any landowner new to the District in the past few years, attend an orientation session, and that new irrigators be oriented as they arrive. In the case of subdivisions, the landowners themselves could be oriented, not just the water masters. In particular, the following items could be included:

- Hammond policies.
- Irrigation techniques and suggestions specific to the Hammond District.
- Best technologies and water and crop management for small parcels.
- Special session for those with no irrigation experience.
- Tips for managing water for part-time farmers with day jobs elsewhere.

An orientation booklet could be developed by District staff and local irrigation specialists for new landowners to take home for reference. With this as a guide, District staff (Business Manager for policies, and the O&M Manager for practices) with help from other experienced irrigators, could present the orientation sessions with help from local specialists as needed. A provision for orienting any new landowners as they arrive could be made.

**9.5 Goal 5 — Water Pricing**: Consider, by Spring 2004, changes necessary to ensure that the District's water pricing structure provides incentives for efficient water use, meets the District's revenue needs, and is clear and equitable.

RATIONAL: There are several reasons for irrigation districts to implement incentive-based pricing systems — in other words, water billing that is related at least partly to the amount of water used:

- The Bureau of Reclamation's Guidebook (Hydrosphere, 2000) clearly recommends that districts consider pricing structures that are "based, at least in part, on the quantity of water delivered."
- Paying for the amount of water actually used can encourage and reward efficient water use.
- Most would consider it fair for those who use more to pay more for the greater benefit they can derive from their water.
- The lack of an incentive-based pricing structure may be construed by outsiders as a lack of commitment to efficient water use.
- There may be real constraints on water supply in the future.

Even if water doesn't seem in short supply at present, droughts, emergence of competing demands for San Juan River water, and reductions in state-determined allowable water application rates are quite likely, if not inevitable, in the future. Progress toward an incentive-based water pricing structure would be wise, and can be phased in very gradually.

**Option 5A — Promote Efficiency with the Water Management Bank:** Although the Water Management Bank can be used to reward efficient water use, its utility to that end is quite limited since the total irrigated land must remain at or below 3933 acres. Yet, it remains an attractive and yet underutilized measure that the District could promote specifically for rewarding efficient irrigators. District customers could be surveyed and any impediments to using the Bank could be explored and rectified if at all possible.

**Option 5B — Move Toward Incentive-Based Pricing:** In light of the fact that the water pricing structure was based largely on water use rather than acreage as recently as 1999, the District could fairly readily determine what adjustments in the per acre foot charge and/or fixed charges could be required to continue to meet the revenue needs that prompted the 1999 policy change.

The USBR's *Incentive Pricing Handbook* (Hydrosphere, 1997) is designed to help districts with this issue. The Handbook provides guidance and worksheets to perform the required analysis. A fixed or flat rate (ie., the same price for each acre foot of water) provides a significant price signal or incentive, meets the fairness test in that irrigators pay for the amount of water they actually use, but avoids much of the uncertainty for the district and irrigators that can come from more aggressive rate structures such as increasing block rates.

An option for making small changes in the desired direction would be to start with a combination rate schedule. Many price structures consist of a fixed charge coupled with a water rate (or per acre foot) charge. By starting with only a small proportion of the total charge generated by water rates and increasing that proportion over time, the move toward a pricing scheme that provides significant and effective efficiency incentives can be achieved with little disruption and sufficient time to fine-tune the revenue stream to meet District needs. The *Incentive Pricing Handbook* provides guidance for constructing such a plan.

**9.6 Goal 6 — Operational Procedures**: Consider, by Fall 2004, any needed changes in operational procedures to ensure that water deliveries are timely and make the most efficient use of water, and that data collection is effective and an efficient use of the staff's time.

RATIONALE: With the Ditchriders being central to effective and efficient water management, those duties must be reviewed frequently. Some concerns were raised about water being "delivered" (or made available) in the morning and not being taken until commuters arrive home after work. The high cost of perhaps adding two additional personnel for afternoon deliveries, has led to a consideration of how automation and remote data access could bring improvements in the effectiveness and efficiency of water deliveries.

Dataloggers have been installed recently at four spill locations, and plans are underway to provide remote data access and automation for the Armenta spill gate and canal gate, and the Sullivan spill gate. If remote access to the other three spill dataloggers is accomplished, and if automation is installed for the main diversion, there may be a decided improvement in the ditchriders use of time and the District's use of water.

The District is interested, however, in also testing the feasibility of a 12-hour delivery schedule to determine its cost-effectiveness. This would be limited to a small number of convenient parcels for testing purposes.

In addition, improvements to the accounting procedures are called for. At present, three separate software packages are used by District staff to monitor water use, land ownership, and financials. A consolidated software program that would monitor all these data would improve the accuracy, cross referencing, and reporting processes.

**Option 6A — Review Ditchriders Procedures**: The District could monitor the effect on the ditrchrider's effectiveness as each of the data access and automation improvements are made. In turn, the findings could be used to plan future technology improvements. The amount of avoidable spills, effectiveness of meeting delivery requests, feedback from irrigators, and job satisfaction of the ditchrider could be monitored. Comparisons could be made between the cost-effectiveness of adding more personnel and adding data access and automation.

**Option 6B — Test Alternative Schedules for Ditchriders:** Irrigators could be asked in a mailing if they would be interested in participating in a pilot project to test a 12-hour delivery schedule rather than the current 24-hour schedule. Staggered shifts for the ditchriders could be considered as well. Results could be evaluated along with the data access and automation findings for future refinement of the delivery scheduling.

**Option 6C — Consolidate District Accounting Software:** The District could purchase the software package identified by District staff that has the ability to monitor water use, parcel ownership, and finances.

**9.7 Goal 7 — Water Shortage Plan:** Develop a plan to cope with any foreseeable water shortages.

RATIONALE: With storage rights in Navajo Reservoir, the chances of a drought-induced shortage are considered small — as recent history has shown. In addition, any drought would have to be rather protracted in order to significantly deplete the Reservoir. For this reason, a surprise drought — one resulting from a lack of precipitation in one season — is unlikely.

However, the combination of a less-than-normal snowpack and competing demands on the San Juan River water from other water rights holders and environmental needs may result in shortfalls in years to come. In addition, very temporary situations may occur in near-normal years when irrigators demand more than can be supplied in any given day. For these reasons, it would be wise for the District to develop the outlines of a Water Shortage Plan to meet immediate needs, and which may be developed more fully as indications of future supply conditions become more clear.

**Option 7 — Develop an Initial Water Shortage Plan**: This plan could include specific measures to address temporary periods when daily demands exceed the District's ability to supply, the relative implications of reduced deliveries on different crops and operations, and an outline of the measures that could be developed over time to address longer term potential shortages in the San Juan River supply.

**9.8 Goal 8 — Reallocation of Water:** Ensure that water allocated to lands which can no longer be irrigated is reallocated to irrigable Class A land as soon as possible.

RATIONALE: It has been several years since a reclassification of irrigable lands, and a reallocation of water has been performed. The last reclassification was in 1995, and the last reallocation of project water was in 1985. As more and more homes and roads are being built, some lands to which water is currently allocated cannot be irrigated. The District would like to have that water reallocated to other irrigable Class A land. Since the project is acreage-limited, the USBR must perform these functions.

**Option 8 — Request Reclassification and Reallocation**: The District could request USBR to undertake a reclassification and reallocation on the Hammond District as soon as possible, and set up a procedure for performing these activities on a regular basis in the future.

## 10.0 EVALUATION OF OPTIONS — What are the best measures for Hammond now?

In this section, the suggested water management options will be evaluated for feasibility and then prioritized.

### 10.1 Analysis & Ranking of Options

Only measures that were considered feasible, effective for promoting better water management, and free of major legal or institutional impediments, were even considered as possible options. Table 10-1, at the end of this section, summarizes several of the remaining factors that were then used in determining the overall ranking of the options. The evaluation process included meetings with District staff and Directors where additional suggestions were made.

**Educational Options (Options 1 through 4):** Options 1 through 4 are more or less educational in nature, and as such, they are very supportive of the USBR's recommendation that education be a prime focus of any good Water Management Plan. Since the District recognizes the sensitivity of gathering on-farm data, the Irrigation Technology Survey (Option 1) will use voluntary and incentive-based methods. Likewise, the District does not feel it is in a position to require the orientation sessions addressed in Option 4, so they will be voluntary. Overall, costs are generally low, although moderate staff time and in-kind assistance from area agencies will be required. Funds will be sought from USBR and other agencies to support the "Irrigation Consultation Visits." All these options were ranked highly.

**Water Pricing Options (Options 5A and 5B):** Since the procedures are in place for the "Water Management Bank," the promotion of its use and the investigation of why it is not yet fully utilized by irrigators is a relatively straightforward step toward using pricing as an incentive for better water management. The fact that the District just switched its pricing structure in 1999 from one based on the actual water used to one based on acreage, makes it very hesitant to make another switch so soon. The District will consider an incentive-based structure in the future.

**Ditchriders Procedures Options (Options 6A, B, and C):** In spite of the potential cost of more hours for the ditchrider staff, the District feels that considerable water waste might be avoided by making 12-hour water deliveries available to those who request them. For this reason, they not only feel it important to investigate the savings from automation, but wish to initiate tests of the 12-hour delivery option. The District staff supports the need for the new comprehensive accounting software.

**Water Shortage Plan (Option 7):** With storage rights in Navajo Reservoir, and with normal and even below normal hydrological conditions, substantial and sustained shortages are unlikely. Because of this, the idea of developing a Water Shortage Plan was initially considered low priority. However, under extreme drought conditions, sharing of shortages with other Navajo Reservoir contractors will be necessary. In the drought of 2002, the Hammond Project received its full water supply, however with the State moving forward with administration of the San Juan River, a water shortage plan should be developed in the event that extreme conditions continue in the San Juan Basin.

**Reclassification and Reallocation (Option 8):** The District sees this as a high priority so that all of its allocated water can be put to good use. A NEPA (National Environmental Policy Act) review will be required according to Pat Page at the Durango office of the USBR (17 December 2002 e-mail).

### 10.2 Review of Bureau's Fundamental Measures

The Bureau of Reclamation calls for a consideration of four fundamental measures in every water management plan: Education, Measurement and Accounting, Coordination, and Incentive Pricing (Hydrosphere, 2000). Education and measurement and accounting measures are very thoroughly addressed in the adopted measures in this plan as well as in current procedures. Coordination is not specifically addressed, but would clearly fall to the Operations Manager and the Business Manager, so they could be considered the "Water Management Coordinators." As indicated earlier in this section, promotion of the Water Management Bank helps address the incentive pricing issue, but the District is not ready to re-institute an incentive pricing rate schedule at this time.

## 10.3 Ranking of Options

The following table summarizes the evaluation of options with the resulting ranking appearing in the last column. A "High" ranking indicates that an option is adopted as a part of this plan and that it will be implemented. A "low" ranking means that the option may be reconsidered in the future.

**Table 10-1: Ranking of Options**

| Option | Costs | | Other Concerns | Relevance to USBR Fundamental Recommend-ations | Environ-mental Concerns (see note below) | District's Overall Ranking |
|---|---|---|---|---|---|---|
| | Staff Time | Other Costs | | | | |
| 1. Technology Survey | Mod | Mod | Privacy concerns | | Low | High |
| 2A. Technology Brochure | Mod | Mod | | Yes | Low | High |
| 2B. Technology Training | Mod | Low | | Yes | Low | High |
| 2C. Consultation Visits | Mod | Mod | | Yes | Low | High |
| 3. In-Service Training | Mod | Mod | | Yes | Low | High |
| 4. New Irrigator Orientation | Mod | Low | | Yes | Low | High |
| 5A. Promote Water Management Bank | Low | Low | Limited to 3933 acres | Yes | Low | High |
| 5B. Move Toward Incentive-Based Pricing | Mod | Low | Considered too disruptive now | Yes | Low | Low |
| 6A. Review Ditchriders Procedures | Low ?? | Low | | Yes | Low | High |
| 6B. Test Alternative Schedules for Ditchriders | Low | Low | | | Low | High |
| 6C. Consolidate District Accounting Software | Low | Mod | | Yes | Low | High |
| 7. Develop Initial Water Shortage Plan | Low | Low | Current drought is raising concern. | | Low | High |
| 8. Request Reclassification and Reallocation | Mod | Mod | | | Low | High |

**NOTE: "NEPA and NHPA compliance will be addressed on each adopted measure deemed a "Federal Action" prior to commencement of such action" (Mark Cody, USBR, Denver, 17 October 2002 e-mail )**

## 11.0 ADOPTED MEASURES & IMPLEMENTATION — How will it be done?

This section lays out the adopted measures as part of a coordinated Plan. Measures were modified as necessary from the previous section to reflect suggestions received and to make them more amenable to implementation.

### 11.1 Specific Existing Water Management Measures to Be Continued

As described in Section 6, the Hammond District has been carrying out a number of excellent programs that contribute to good water management. While this section focuses on new measures, the continuation of existing measures is assumed, especially the following:

- Canal lining monitoring and maintenance to ensure that seepage remains at a minimum.
- Educational programs including the Water Masters School.
- Water measurement improvements and monitoring of impacts on overall water management.

### 11.2 Adopted Measures

**Measure 1 — Irrigation Technology Survey**: A survey will be conducted to determine the type and state of irrigation application equipment being used at present on each parcel in the District. Due to the potential for improvements on small parcels, an attempt will be made to survey all parcels. The survey will seek the following information:

- The type of technology (eg. sideroll, drip, gun, emitter type, nozzle type, etc.).
- Its age and state of repair (to the extent possible).
- The relative amount of leakage.
- The crops and area of land served.

- Other pertinent data.

The survey will be accomplished in three steps:

- A mailing will make all irrigators aware of the voluntary survey and request that they mail back their information.
- District staff will contact those who did not mail in their survey data, and ask if they could arrange a farm visit to gather the data. Visits could be conducted by staff or students or others hired by the District, who would be introduced to the irrigators before beginning the survey visits.
- Data on any remaining parcels could be sought during the irrigation consultations described in Measure 2C.

Depending on how many surveys are accomplished by mail, most of the irrigators could be surveyed in 2 to 3 years. The District will consider how to incorporate data on changes in irrigators' technologies into annual crop and water reports, so that data will remain current.

**Measure 2A — Irrigation Technology Brochure**: The District will consult with local irrigation specialists including Extension, NRCS, USBR, the NMSU Ag Science Center, and others to review the Irrigation Technologies Survey data and identify the most feasible and productive improvements appropriate for the District's irrigators. Special attention will be given to systems best for small parcels that are becoming more common in the District. Improvements will consist of:

- New application systems (such as drip irrigation for example).
- Renovations of existing systems (such as new types of sprinkler nozzles).
- Maintenance (such as replacement of worn sprinkler nozzles).
- Leak repair and reduction technologies (gaskets, etc.).
- Soil moisture sensing equipment.

A brochure will be produced describing the selected available technologies, sources of technical assistance, and possible sources of financial assistance. This brochure will be distributed to each irrigator in the District.

**Measure 2B — Irrigation Technologies Training:** The District will provide irrigation technology training annually (as part of the annual workshops described in Measure 3 below) to provide interested irrigators with more in-depth exposure to the technological options available to them. Local specialists from Extension, NRCS, USBR, and NMSU will conduct the trainings which may include tours to see examples of the new technologies on farms in the District and perhaps at the NMSU Ag Science Center.

**Measure 2C — Irrigation Consultation Visits:** The District will seek funding or in-kind assistance from USBR, NRCS, Extension, and other groups in order to offer free consultation visits by irrigation specialists to evaluate the technologies, scheduling, and crop management techniques used by irrigators, and suggest any needed improvements. Sometimes called "audits," these visits will be voluntary, and will help meet the objectives of the "Technology Assessment" and "In-Service Training" measures (Measures 1 and 3).

**Measure 3 — In-Service Training Workshops**: In-service training will focus on an Annual Irrigation Workshop relying on local NRCS, Extension, NMSU, and other specialists using a combination of workshop sessions and tours to accomplish the training. Topics will include:

- Irrigation scheduling.
- Soil moisture determinations.
- Appropriate crop and variety selection.
- Crop management for optimum water use and yield.
- Pasture and grazing management for efficient water use.
- Irrigation technologies training (Measure 2B).

Rather than presenting a textbook approach to all possible management options, the District will work with presenters to address the most appropriate and feasible options specifically suited to the Hammond District. Dan Smeal and other staff of the NMSU Ag Science Center have a wealth of site-specific information and assistance to offer including irrigation scheduling programs and knowledge of moisture monitoring equipment that the District could loan to irrigators.

In addition to the Annual Workshop, the following measures will provide additional in-service training:

- Personalized, on-farm training will occur as needed during the “Irrigation Consultation Visits” under Measure 2C.
- The District will actively publicize the annual “Four Corners Irrigation Workshop,” and the Farmington Ag Science Center’s “Open House” functions.
- The District will encourage attendance at its “Water Master School” each season.
- The District will sponsor the appropriate staff attendance at outside workshops related to O & M procedures.
- The District will consider sources of funds to support the attendance at area workshops by District irrigators in the future.

**Measure 4 — New Irrigator Orientation Sessions**: The District will strongly encourage any landowner new to the District in the past 5 years to attend an orientation session, and new irrigators to attend a session after they arrive. In the case of subdivisions, the landowners themselves will be oriented, not just the water masters. In particular, the following items will be included:

- Hammond policies.
- Irrigation techniques and suggestions specific to the Hammond District, including operation of CHO turnouts.
- Best technologies and water and crop management for small parcels.
- Special session for those with no irrigation experience.

- Tips for managing water for part-time farmers with day jobs elsewhere.

An orientation booklet will be developed by District staff and local irrigation specialists for new landowners to take home for reference. With this as a guide, District staff (Business Manager for policies, and the O&M Manager for practices) with help from other experienced irrigators, will present the orientation sessions with help from local specialists as needed. Orientation sessions will be held annually before the beginning of the irrigation season. New irrigators will be encouraged to attend the orientation in the Spring after they arrive, but will receive the orientation booklet upon arrival.

**Measure 5A — Promote Efficiency with the Water Management Bank:** The District will promote the use of the Water Management Bank as a means of rewarding efficient irrigators. District customers will be asked to provide feedback on use of the Bank, and any impediments to using the Bank will be explored and rectified if at all possible.

**(Option 5B — Move Toward Incentive-Based Pricing:** To be considered later.)

**Measure 6A — Review Ditchriders Procedures**: The District will monitor the effect on the ditrchrider's effectiveness as each of the data access and automation improvements are made. In turn, the findings will be used to plan future technology improvements. The amount of avoidable spills, effectiveness of meeting delivery requests, feedback from irrigators, and job satisfaction of the ditchrider will be monitored. Comparisons will be made between the cost-effectiveness of adding more personnel and adding data access and automation. Reports will be prepared each Fall.

**Measure 6B — Test Alternative Schedules for Ditchriders:** Irrigators will be asked in a mailing if they would be interested in participating in a pilot project to test a 12-hour delivery schedule rather than the current 24-hour schedule. Staggered shifts for the ditchriders will be considered as well. Results will be evaluated along with the data access and automation findings for future refinement of the delivery scheduling. A report will be prepared on the results of the test.

**Measure 6C — Consolidate District Accounting Software:** The District will consider purchasing the software package (from Rim Rock Computing) identified by District staff that has the ability to monitor water use, parcel ownership, and finances. The USBR will be asked to assist in its purchase, which is approximately $10-12,000 including training and one year of technical assistance.

**Measure 7 — Develop an Initial Water Shortage Plan:** The District will start discussion of a plan. This plan may include specific measures to address temporary periods when daily demands exceed the District's ability to supply, the relative implications of reduced deliveries on different crops and operations, and an outline of the measures that could be developed over time to address longer term potential shortages in the San Juan River supply.

**Measure 8 — Request Reclassification and Reallocation:** The District will request USBR to undertake a reclassification and reallocation on the Hammond District as soon as possible, and set up a procedure for performing these activities on a regular basis in the future. In preparation for reclassification, the District will request that USBR assist them in ensuring that the current classified land parcels are accurately entered on an electronic GIS system.

### 11.3 Cost Considerations

The primary costs for these measures are of three kinds: 1) staff costs for planning, publicity, and administration; 2) printing, mailing, and workshop costs; 3) major expenses only incurred if funding is secured from USBR or other sources. In addition, in-kind assistance is anticipated from local experts in NRCS, USBR, Extension, NMSU Farmington Ag Science Center, and elsewhere. Therefore the unaided financial burden on the Hammond District to implement these measures is comparatively small in light of the benefits to be gained. A summary of cost considerations can be seen below in Table 11-1.

**Table 11-1: Cost Considerations of Adopted Measures**

| Measure | Costs | | Potential Sources of Funding and Assistance |
|---|---|---|---|
| | Staff Time | Other Costs | |
| 1. Technology Survey | Preparation of survey and compilation of responses | Mailing costs | Local experts tech. assistance |
| 2A. Technology Brochure | Planning and administration | Layout, printing, and mailing costs | Local experts tech. assistance |
| 2B. Technology Training | Planning and publicity | Workshop costs | Local experts tech. assistance |
| 2C. Consultation Visits | Planning and administration | Consulting fees | Seek USBR funding and NRCS, Extn, NMSU in-kind assistance |
| 3. In-Service Training | Planning and publicity | Workshop and tour costs | Seek USBR funding and NRCS, Extn, NMSU in-kind assistance |
| 4. New Irrigator Orientation | Planning and publicity | Meeting and brochure costs. | Local experts tech. assistance |
| 5A. Promote Water Management Bank | Publicity, survey, and compilation of data. | | |
| 6A. Review Ditchriders Procedures | Reporting | | |
| 6B. Test Alternative Schedules for Ditchriders | Planning and reporting | | |
| 6C. Consolidate District Accounting Software | (Should reduce reporting time) | $10-12,000 | Request of BOR |
| 7. Develop Initial Water Shortage Plan | Planning and meetings | | |
| 8. Request Reclassification and Reallocation | Assist USBR | USBR expenses | Major costs born by USBR |

## 11.4 Scheduling

The scheduling considerations consist of 1) what measures are needed most, 2) what measures are dependent on the completion of other measures, 3) availability of funding, and 4) spreading the implementation out so that the staff workload is reasonable.

Consideration 2 above dictates that initial results from the Technology Survey be used in preparing the Technology Brochure, and in planning of the Technology Training Sessions. Staff has indicated that the new accounting software is needed at the present time, and that funds from USBR could be readily available. Below, Table 11-2 outlines the schedule of activities to accomplish the adopted measures.

**Table 11-2: Implementation Schedule**

| Measure | Start Date | Completion Date |
|---|---|---|
| 1. Technology Survey | Spring 2003<br>(initial survey mailing) | Fall 2003 (initial results compiled)<br>Fall 2005 (survey complete) |
| 2A. Technology Brochure | Fall 2003 | Spring 2004 |
| 2B. Technology Training | Summer 2004<br>(first training session) | Continues annually |
| 2C. Consultation Visits | Summer 2004<br>(first visits) | Ongoing |
| 3. In-Service Training | (Summer 2004<br>(first workshop) | Continues annually |
| 4. New Irrigator Orientation | Spring 2003<br>(brochure prep. begins) | Spring 2004<br>(first orientation — then annually thereafter) |
| 5A. Promote Water Management Bank | Spring 2003<br>(survey mailed) | Spring 2004<br>(impediments addressed and initial Water Man. Bank promotion completed) |
| 6A. Review Ditchriders Procedures | Fall 2003<br>(report on 2003 season) | Continues annually |
| 6B. Test Alternative Schedules for Ditchriders | Fall 2003<br>(questionnaire goes out) | Fall 2004<br>(report on 2004 season test) |
| 6C. Consolidate District Accounting Software | Spring 2003<br>(purchase request made) | Spring 2003<br>(software purchase considered) |
| 7. Develop Initial Water Shortage Plan | Spring 2003<br>(Discussions begin) | (Discussions ongoing) |
| 8. Request Reclassification and Reallocation | Spring 2003<br>(request submitted to USBR) | Spring 2003 (request considered — completion of process will depend on USBR) |
| Plan Evaluation and Updating (see Section 12) | Fall 2003<br>(Agenda item at Board meeting) | Continues annually |

## 12.0 MONITORING, EVALUATING, AND UPDATING — How will the plan be kept up-to-date?

| |
|---|
| This section describes how progress in meeting the goals of this Water Management Plan will be monitored and evaluated, and how the Plan will be revised as needed. |

### 12.1 Monitoring and Evaluating Progress

This plan should be considered a work-in-progress. Over time, measures are implemented and hopefully many goals are met. However, some measures may need to be adjusted to meet stated goals of the Plan. New issues may suggest entirely new goals and measures for the District. The continual evaluation and revision of this Plan is critical to improved water management, and saves the time and expense of creating an entirely new Plan at some point in the future.

Careful monitoring is a prerequisite of keeping the Plan current. Several of the adopted measures call for reports upon completion or annually. The remaining measures are relatively easy to monitor (workshops held, number of participants, use of the Water Management Bank, etc.), and can be included in an annual report.

### 12.2 Updating the Plan

Progress toward implementation of the adopted measures and meeting the goals of the Plan should be evaluated at least annually at a Board of Directors meeting. The public should be invited to comment on the Plan, progress, and needed modifications. Any adjustments or additions to the Plan can be made at that time. The annual Plan evaluation has been added to the Implementation Schedule, Table 11-2.

## 13.0 REFERENCES CITED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## 14.0 IRRIGATION INFORMATION RESOURCES

Here are some resources and contacts that may be of special help in implementing the measures in this Plan and for additional help with efficient irrigation.

**Local Agency Offices —** First of all, start with local Natural Resources Conservation Service, Extension, and Bureau of Reclamation offices.

**NMSU's Agricultural Science Center at Farmington** — Invaluable information on irrigation suited to this very location. Local resident Dan Smeal is one of the irrigation specialists at the Center: Phone: (505) 327-7757

**New Mexico Climate Center Website** — Daily weather summaries, local weather data, irrigation scheduling programs, and links: http://weather.nmsu.edu

**WRRI, New Mexico Water Resources Research Institute** — A comprehensive state site at: http://wrri.nmsu.edu/

**US Bureau of Reclamation WaterShare Program —** Efficiency information and links to regional websites: www.watershare.usbr.gov

**US Bureau of Reclamation Upper Colorado Office** — Local and regional news and information and a portal to the national USBR website: www.uc.usbr.gov/

**National Water and Climate Center** — Part of the Natural Resources Conservation Service, with plenty of steam flow, reservoir, and precipitation data, both real-time and historical, for monitoring your water supply: www.wcc.nrcs.usda.gov/wcc.html

**EPA's "Surf Your Watershed"** — Website at www.epa.gov/surf/ has environmental information on watersheds across the country, including the San Juan River.

**USGS: US Geological Survey** — Provides real-time stream flow data for New Mexico at http://waterdata.usgs.gov/nm/nwis/rt

**Southwestern Water Conservation District's Water Information Program** —A very useful regional educational website at: http://waterinfo.org/

**The Center for Irrigation Technology** — In Fresno, California with educational and technical resources on irrigation scheduling and links to a multitude of other irrigation sites at www.wateright.org/index.asp

**Rocky Mountain Institute —** Resource efficiency research organization with practical water and energy-savings information. Snowmass, CO; 970-927-3851; www.rmi.org