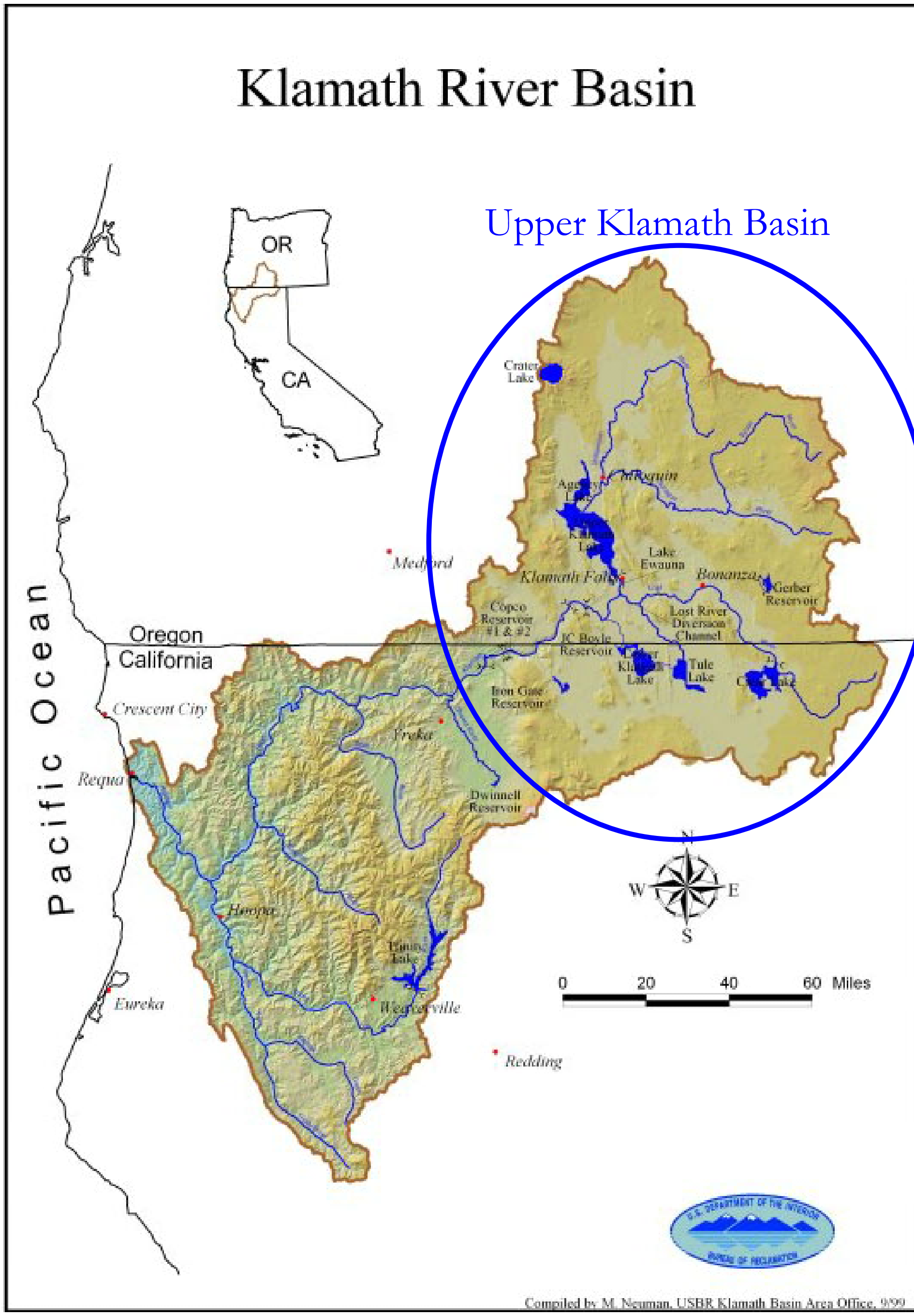
Coping with Competition for Water

Irrigation, Economic Growth, and the Ecosystem in the Upper Klamath Basin



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EXECUTIVE SUMMARY & READER'S GUIDE

This report examines relationships between water and the economy in the Upper Klamath Basin, and explores win-win options for pursuing both a healthier ecosystem and a more prosperous economy.

CONFLICT OVER THE BASIN'S WATER STEMS FROM LONG-STANDING, INTENSIFYING COMPETITION

Recent events in the Basin, with farmers denied use of federal facilities to obtain water for irrigation, have caused farmland to remain dry, heightened the threat of economic ruin for farm families, and generated intense political controversy. Many characterize these events as unexpected and imposed by federal bureaucrats enforcing the Endangered Species Act. The economic analysis in this report, the bulk of which was prepared prior to these events, places them in a larger context and offers a more fundamental explanation: The events are not surprising but an outgrowth of powerful forces underlying the long-standing competition for water.

Competition for the Basin's water is not new

For a century, demands for the Basin's water have exceeded supplies, but there have been no market mechanisms to bring demand and supply into balance; for decades, irrigators have used water while other, higher-value uses have withered; and, for years, the economic values associated with irrigators' demands have weakened relative to those of competing demands. As pressures for change mounted, something had to give. The enforcement actions under the Endangered Species Act were triggered by groups competing with irrigators for water but unable to have their demands accommodated via other mechanisms. Whatever the outcome from these actions, pressure for change in how the Basin's water is used will continue to come from economic, competitive forces.

Competition for the Basin's water comes from many groups and interests

Pressure for change comes largely from groups injured by the adverse impacts of irrigated agriculture on the Basin's ability to provide natural ecological services, such as higher streamflows, higher water quality, and better habitat for fish and wildlife. These impacts arise from the conversion of wetlands to farms, the withdrawal of water from lakes and streams, and the introduction of pollutants into runoff from farmlands. Because of the reduced ecological productivity:

- Tribal members in the Upper Basin lost access to fish, now endangered, that are unique to the Basin and important to their economic well-being and culture.
- Tribal members in the Lower Basin similarly suffered as they lost access to salmon, which the Basin once produced in great numbers, but are now listed as threatened.
- Participants in the commercial and recreational fishing industries along the Pacific coast lost jobs, incomes, industrial output, and recreational opportunities due to reduced salmon populations.
- Bird watchers and hunters have endured reductions in waterfowl populations.
- Residential, commercial, and industrial interests seeking to capitalize on the Basin's quality of life have been frustrated by the loss of native wetland habitat, reductions in populations of native species, and degradation of water quality.
- Electricity consumers have experienced higher rates as water that otherwise would pass through hydroelectric dams on the Klamath River instead went to irrigate crops.

Irrigation, alone, is not totally responsible for these and related impacts. But it has played a major role and the competition for water associated with the affected groups and interests cannot be accommodated without a change in irrigation levels and practices.

Irrigation's demand for water is diminishing relative to others

At some level of use, water can be more valuable when used for irrigation than for other uses. Whatever this level in the past, however, it has declined, as farming in the Basin has been reshaped by market forces. In 1970, earnings in the farm sector accounted for 8 percent of Klamath County's total, but this had fallen to 0.5 percent by 1998. In 1997, 46 percent of the county's farms had sales less than $10,000 and, of those that exceeded this level, 37 percent experienced losses averaging $19,139. Prices for many farm commodities have tumbled since then and the structure of the agricultural industry is changing, making it ever harder for farmers to reverse the trend.

At the same time, economic values have increased for other water uses, especially those associated with high-quality, natural-resource amenities. Also, tribal members and others deprived of water have become more assertive in pressing their demands.

THERE ARE SOME WIN-WIN OPPORTUNITIES

Irrigators, and the other parties with an interest in resolving the conflict in the Basin, have several options. Many of these entail leaving the different, competing interests to slug it out in the courts, Congress, and the media in a winner-take-all contest. There are, however, some win-win opportunities. These entail:

- **Promoting sustainable practices by agricultural and other water users**. Mounting evidence indicates that sustainable practices can increase farmers' profits and lower costs for municipal-industrial water users. Residents of the Upper Basin, however, have adopted few of these practices, lagging behind their neighbors. The time may be ripe to pursue these opportunities.
- **Promoting the use of market mechanisms to shift resources from low- to high-value uses**. Specific mechanisms include water banking and conservation easements. These tools create incentives for farmers to produce both commodities and ecological services.

Farmers have essential roles to play in these activities, but there is much that community leaders, environmental groups, and others can contribute. Increasing the viability of farms *and* improving the environmental impacts of farming may be something that farmers, environmental groups, the tribes, and other groups can agree on.

Experience elsewhere in the region during 2001 demonstrates the feasibility of these options. Numerous water users found that sustainable practices increase profits. Electric utilities in the Columbia Basin established mechanisms to compensate irrigators for leaving water in streams. Public programs provided incentives to reduce impacts on streams. Private organizations negotiated conservation easements and other instruments, increasing income for farmers in return for enhanced environmental protection. Collaborative processes have found ways to improve streamflows with little acrimony. Similar actions in the Klamath Basin should yield similar benefits for both the environment and the economy.

WHAT DOES THIS REPORT CONTAIN?

This report has three chapters. In the first chapter, "Competition for the Basin's Water" we characterize the competing demands for water in the Upper Klamath Basin. Demand, in this setting, refers not just to those who seek tangible possession of water but also those who have a more indirect interest in how the Basin's water is managed. We aggregate the numerous individual demands into four groups, describe the salient characteristics of each group, and describe how they interact.

In the second chapter we discuss four, strategic options for accommodating the growing competition for water in the Basin:

- Resist the reallocation of water to those with ecological demands.
- Develop new sources of water or water-storage infrastructure.
- Retain the general scale and pattern of current out-of-stream water uses, but reduce the ecological harm.
- Change the general scale and pattern of current out-of-stream water uses.

In the third chapter we discuss potential win-win opportunities for accommodating the growing competition for the Basin's water. Our highest priority is to promote sustainable practices that would markedly reduce the adverse ecological impacts of farming and urban growth while increasing farmers' earnings and reducing taxes and utility rates for households and firms. Our second priority is to develop market mechanisms to shift water and related resources from low-value to high-value uses.

WHO PREPARED THIS REPORT?

Ernie Niemi, Anne Fifield and Ed Whitelaw are the authors. We are economists with ECONorthwest, the oldest and largest economics consulting firm in the Pacific Northwest. This report was prepared at the request of Public Interest Projects, a non-profit organization. The organization's Klamath Project seeks to provide information to stakeholders interested in solving environmental controversies in the Klamath Basin. Public Interest Projects received funding to conduct this research from the Brainerd Foundation and the Harder Foundation. We greatly appreciate the assistance and patience afforded us by numerous individuals, especially the members of the

board of the Klamath Basin Ecosystem Foundation (KBEF). Assistance from them and others notwithstanding, we remain solely responsible for the contents of this report, and the views expressed herein do not necessarily represent the views of the individuals who assisted us.

We have prepared this report based on our general knowledge of the economy of the Upper Klamath Basin, as well as information derived from government agencies, private statistical services, the reports of others, interviews of individuals, or other sources believed to be reliable. We have not verified the accuracy of such information, however, and make no representation regarding its accuracy or completeness. Any statements nonfactual in nature constitute our current opinions, which may change as more information becomes available. As time passes, the results of this report should not be used without accounting for more recent data and relevant assumptions.

HOW CAN YOU GET ADDITIONAL INFORMATION?

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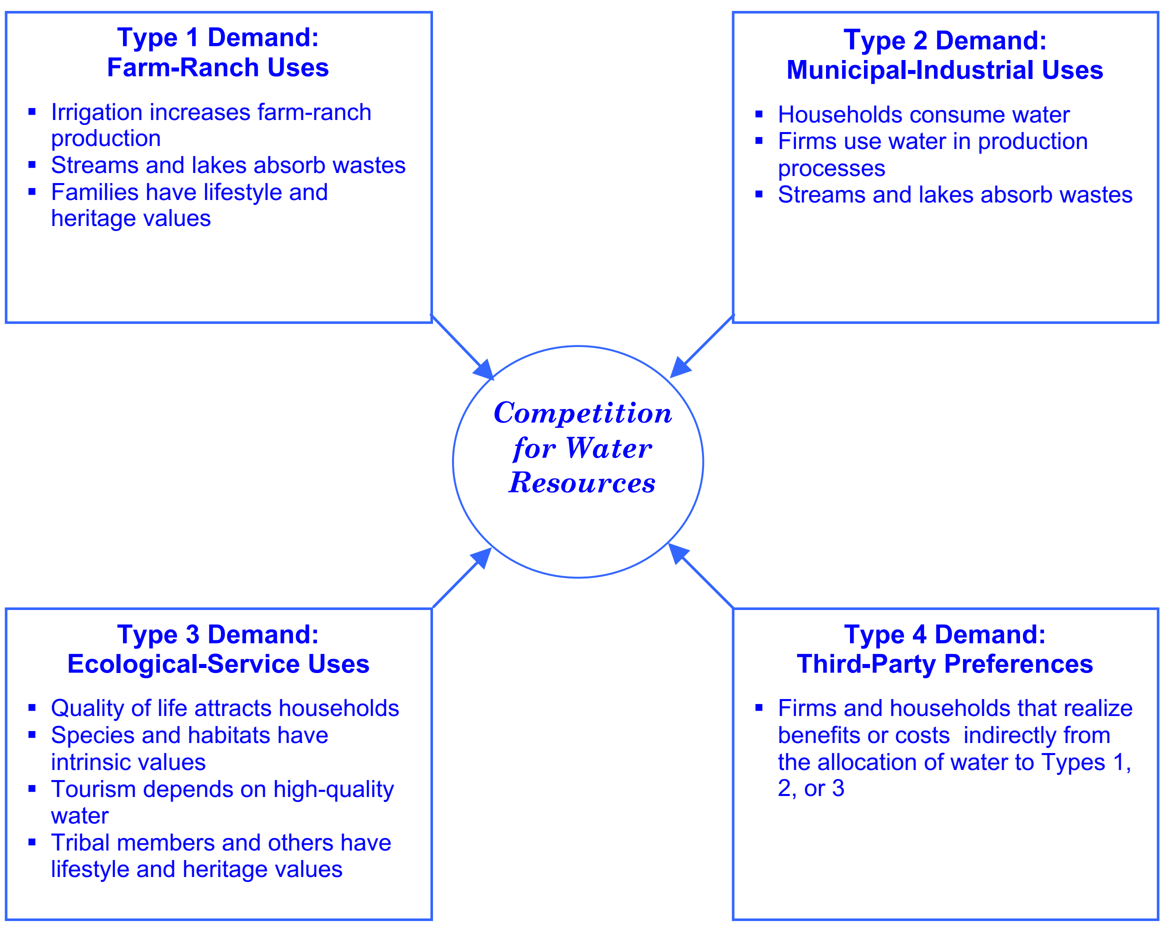
COMPETITION FOR THE BASIN'S WATER

In this chapter we describe the major types of demand competing for surface water in the Upper Klamath Basin, as shown in Figure 1. In this context, "demand" refers not just to those—such as farmers wanting water for irrigating their fields, or municipal utilities wanting water for their customers—who want to acquire possession of surface water, remove it from a stream, and use it to their advantage. These certainly are important types of demand competing for the Basin's water. They are not alone, however. Others also are competing for the water, even though they do not necessarily want to acquire possession.

Figure 1: The Competing Demands for Water in the Upper Klamath Basin



These demands for water come from those who want the water left in the streams for ecological, spiritual, recreational, and other purposes. Additional demands come from those who benefit from others' use of water, such as when a grocery store sells to farmers or tourists.

There are countless ways to depict all these competing demands, but we opt for an approach that lumps them into four types, which are useful for highlighting the major economic issues surrounding the competition for the Basin's water. Figure 1 illustrates these four types of demand and provides a brief description of each. The first three types—associated respectively with farm-ranch, municipal-industrial, and ecological-service water uses—represent households and firms that directly derive economic benefits when water is allocated to meet their demands. The fourth type of demand is less direct. It includes households and firms that are said to have a third-party interest in the water because, although they do not directly compete for water, they can experience substantial economic gains and losses from how water is managed and used through their interactions with the more direct beneficiaries.

Figure 1 depicts the four types of demand as individually cohesive and mutually exclusive and, to a great extent, they are. There are, however, some important exceptions. Within each type of demand, there can be competition, as when different farmers compete among themselves. It also is important to recognize that one person, household, or firm can express more than one type of demand. Many members of farming households, for example, work in other industries and have strong affinities for the fish and wildlife dependent on a healthy, water-related ecosystem in the Basin

TYPE 1 DEMAND: FARM-RANCH USES

Farmers and ranchers in the Basin demand water to increase their production of crops and livestock and remove waste products. They also employ irrigation water to sustain a way of life and a legacy from earlier generations that many treasure. There is, however, no single way to represent the strength of farm-ranch demands for water, so we present data that provide insight into the number of families supported by farms and ranches, the extent of irrigation, and the economic return on irrigation.

Farms, ranches and workers dependent on irrigation

Table 1 shows data, from the 1997 Census of Agriculture, for Klamath County, all of which lies in the Basin, and for Siskiyou and Modoc Counties, parts of which lie in the Basin. Of all the farms and ranches in the three counties, 1,744, about 80 percent, used irrigation. The most heated competition for water involves a somewhat smaller number of farms and ranches, however: those in Klamath County, plus those farming on about 100,000 acres in California that use water from the Bureau of Reclamation's Klamath Project.

In addition to the owners or operators of these farms and ranches, it seems reasonable to assume irrigation also supported most of the 6,238 hired farm workers in the three counties.

Table 1: Number of Farms (including Ranches) in the Upper Klamath Basin, 1997

		Klamath	Siskiyou	Modoc	Total
Farms	number	1,066	733	440	2,239
Acres		713,534	628,745	662,927	2,005,206
Average size (ac.)		669	858	1,507	896
Median size (ac.)		109	142	341	----
Hired farm workers	no.	1,779	2,795	1,664	6,238
Payroll	$1,000	9,745	11,309	6,169	27,223
Farms with irrigation	no.	851	556	337	1,744
Irrigated acres		243,205	139,534	159,219	541,958
Avg. per farm	acres	286	251	472	311
-- w/ harvested cropland	no.	582	414	309	1,305
Total acres		135,888	95,306	115,805	346,999
Irrigated acres		132,178	86,874	111,395	330,447
-- Irrig. hay, alfalfa, etc.	no.	522	308	252	1,082
Irrigated acres		90,319	63,500	81,425	235,244
-- Irrig. grains[a]	no.	169	99	98	366
Irrigated acres		31,427	14,577	16,589	62,593
-- Irrig. vegetables	no.	5	28	12	45
Irrigated acres		279	753	2,557	3,589
-- w/ pastureland	no.	661	392	216	1,269
Total acres		398,926	337,361	397,013	1,133,300
Irrigated acres		111,027	52,660	47,824	211,511

[a] Includes wheat, oats, and barley.

Source: U.S. Department of Agriculture (1999a; 1999b).

Only about half of all the farms and ranches counted in the census had sales of at least than $10,000, which is a threshold used to identify farms and ranches where commercial sales are an important source of income. About 90 percent of those with sales above this threshold used irrigation, and we discuss them later in this chapter.

Klamath County contains 45 percent of the more than 500,000 irrigated acres in the three counties, as well as about 60 percent of the lands irrigated with water from the Klamath Project. Hence, to facilitate our discussion, we focus mostly on the data for this county. The data in Table 1 show that farm operations in Klamath County that irrigated pastureland outnumbered those that irrigated cropland, but there were more acres of irrigated cropland. About 54 percent of irrigated land in Klamath County produces harvestable crops, with the remainder primarily providing pasture for livestock. Nearly all land that produced harvested crops was irrigated, but less than 30 percent of all pastureland was irrigated. Two-thirds of the irrigated cropland in Klamath County produced hay, alfalfa, and related crops.

The largest farms and ranches have the most irrigated land:

a. More than three-quarters of the irrigated acreage in Klamath County is found on the 219 largest farms and ranches:

b. 64 operations, with at least 2,000 acres each, contain 42 percent of the irrigated acreage in Klamath County (average: 1,582 acres per farm or ranch).

c. 50 operations, with 1,000-1,999 acres each, contain 16 percent (average: 793 acres per farm or ranch).

d. 105 operations, with at least 500-999 acres each, contain 19 percent (average: 432 acres per farm or ranch) (U.S. Department of Agriculture 1999b).

Irrigation-related water use

Other indicators of farm-ranch demand for water come from the amount of water used. A 1990 analysis of the Oregon portion of the Basin by the U.S. Geological Survey (USGS) found that, on average, 4.1 feet of water was applied to land producing potatoes, and 3.6 feet to other irrigated land (Broad and Collins 1996). The data in Table 2, derived from this study, show that nearly all—92 percent—of the water withdrawn for irrigation came from surface-water sources. In all, irrigators withdrew about 945,000 acre-feet of water from surface-water sources. The 100,000 acres in California irrigated with water from the Bureau of Reclamation’s Klamath Project, use another 370–400,000 acre-feet of water, most of which originates in Oregon.

In Klamath County, most irrigation occurred in the Lost River sub-basin: with 54 percent of the irrigated land, it accounted for 58 percent of the water withdrawals. In contrast, each of the upper sub-basins, associated with the Williamson and Sprague Rivers, accounted for about 10 percent of the irrigated land and withdrawals. The Upper Klamath Lake area accounted for almost one-quarter of the total.

Of the water withdrawn and used for irrigation in the Oregon portion of the Basin, the USGS researchers found that about 21 percent was "lost," i.e., it seeped into the ground or evaporated, during conveyance. This level of conveyance loss is common in the Pacific Northwest. About 36 percent of the water withdrawn for irrigation in the Oregon portion of the Basin was actually consumed by crops. In other words, 63 percent of the water withdrawn later evaporated, seeped into the ground, or ran off irrigated lands and returned to canals, streams or lakes. Another 45,500 acre-feet of water—equivalent to more than half the irrigation water withdrawn in the Sprague River sub-basin—evaporated from Upper Klamath Lake and other reservoirs as it was stored there for irrigation and other purposes (Broad and Collins 1996, p. 129).

Table 2: Annual Irrigation Water Use, Oregon Portion of the Basin, 1990 (1,000 acre-feet)

	Withdrawals[a]			Conveyance Loss	Consumption
	Ground	Surface	Total		
Williamson R.	9	85	94	19	41
Sprague R.	0	87	87	19	38
Klamath Lake[b]	5	224	224	45	90
Lost River	83	549	627	134	202
Total	97	945	1,032	217	371

Source: ECONorthwest, with data from Broad and Collins (1996).

[a] Individual values may not add to totals because of independent rounding. These data do not reflect changes in withdrawal patterns steming from actions to limit surface withdrawals and develop new wells.

[b] Includes the Wood River sub-basin.

The efficiency of irrigation systems reflects several factors, including the porosity of soils, the configuration and porosity of canals, and the efficiency of irrigation systems. Within Klamath County, only one-third of the irrigated acreage was irrigated with sprinklers, with which crops consume 65-85 percent of the water applied to the field. Two-thirds of the acreage was irrigated by flood-irrigation methods, where crops typically consume only 45 percent of the water applied (Broad and Collins 1996, p. 13). Irrigation efficiency was highest in the Lost River sub-basin, where methods other than flood irrigation were used to irrigate 57 percent of all irrigated acreage. In the remainder of the Oregon portion of the Basin, flood-irrigation was used on more than 90 percent of irrigated acreage.

Livestock consume little of the water withdrawn for farms and ranches. In 1990, livestock consumption totaled slightly more than 1 million gallons per day, or about 3 acre-feet per day. Far more important is the amount of water used to grow feed for livestock.

Earnings and capital values derived from irrigation

In economic terms, the most telling indicators of the strength of farm-ranch demands for water relate to the sales, earnings, and capital values derived from the use of water. Again, no single variable tells everything we'd like to know, but the census data reported in Table 3, which describe farms and ranches with sales of at least $10,000 in 1997, provide some important insights. Of the 1,066 total farms in Klamath County, 576, or 54 percent, had sales of this level.

Table 3: Financial Characteristics of Farms (Including Ranches) in Klamath County with Sales of $10,000

		1997
Farms, total[a]	no.	576
Acres		625,676
Avg. size	acres	1,086
Sales	1,000	$98,974
Expenses	1,000	$76,399
Net cash return	1,000	$21,220
Avg. per farm		$36,904
Avg. per acre		$34
Farms w/ net gains	no.	360
Avg. net gain per farm		$70,373
Farms w/ net losses	no.	215
Avg. net loss per farm		$19,139
Farms selling crops	no.	342
Sales	1,000	$50,954
Avg. per farm	1,000	$149
Farms selling l'stock	no.	416
Sales	1,000	$48,020
Avg. per farm	1,000	$115
Value of land & bldgs.		
Avg. per farm	1,000	$777
Avg. per acre		$818
Value of eqpt. & mchnry.		
Avg. per farm	1,000	$117
Avg. per acre		$108

[a] 517 irrigated farms and ranches in Klamath County earned at least $10,000, with 224,535 total acres and 434 acres per farm. Data for other variables not reported for irrigated farms.

Source: U.S. Department of Agriculture (1999b). Census of Agriculture.

Although the census reports do not show financial data separately for irrigators, they do indicate that most of the farms and ranches with sales of at least $10,000 were irrigators. In Klamath County, of the 576 farms and ranches with this level of sales, 517, or 90 percent, were irrigators. Hence, it seems reasonable that most of the reported financial data apply to irrigators with 1997 sales of at least $10,000.

The data in Table 3 show that sales totaled $98,974,000 in Klamath County, and the average per farm or ranch was $171,829. Of the total, 51 percent came from 342 farms that sold crops, with the remainder accruing to the sale of livestock, poultry, and other products. Hay, alfalfa, and related products accounted for 44 percent of crop sales.

Production expenses totaled $76,399,000, or 77 percent of sales, and the net cash return was $21,220,000, or $36,904 per farm or ranch, on average. The net cash return per acre was $34, but not all farms and ranches fared equally. More than one-third of those with sales of at least $10,000 had a net loss, averaging $19,139 each. For the 360 farms and ranches that made money, the total net gain was $25,334,000, or $70,373 each, on average. If farms in each group had the same average size, 1,086 acres, as all farms with sales of at least $10,000, then those with a net loss, lost $18 per acre, and those that with net gains earned $65 per acre.

Farms that sold crops yielded higher net earnings than farms that sold livestock. Farms that sold crops—nearly all of which used irrigation—averaged net earnings of $149,000 from such sales. For those that sold livestock, the average net earnings from such sales was $115,000.

The data on the value of land, buildings, machinery, and equipment provide additional information about the economic values associated with the farm-ranch demand for water. On average, the capital value exceeds $900,000, or about $900 per acre, for each farm or ranch with annual sales of at least $10,000. Actual capitalized values would vary from farm to farm, reflecting differences in the productivity of lands and farmers' production methods. But, at the extreme, if one assumes that the loss of access to irrigation water meant a farming operation would become wholly infeasible, the land uninhabitable, and the value of buildings lost, then the owner would lose about $800,000, on average, or $800 per acre (for the purposes of this exercise, it is reasonable to assume the farmer could sell the machinery and equipment). This is an extreme case, to illustrate the upper bound of the average, capitalized value of lands and buildings associated with irrigated agriculture in the Basin.

Other studies offer additional, rough insights into the financial importance of irrigation. Perhaps the most significant study examined the sales during the early 1990s of more than 200 parcels of irrigated and unirrigated farmland, with different soils, sizes, and other characteristics, in Malheur County, Oregon, which resembles the Klamath Basin in many respects (Faux and Perry 1999). The authors found that the economic importance of water depends on the productivity of the soils being irrigated. As shown in Table 4, perennial access to water to irrigate the most productive soils—Land Class I, as determined by the Natural Resources Conservation Service—increases the value of the land by $2,551 per acre, but being able to irrigate less productive land with soils in Land Class V increases its value by only $514 per acre. The researchers found that the productivity of soils with a Land Class higher than V is too low to warrant irrigation, and the base value of unirrigated land was $367 per acre.

Table 4: Value of Irrigation Water in Eastern Oregon

	Land Class				
	V	IV	III	II	I
Value of perennial delivery of water					
Per acre	$514	$595	$1,122	$1,743	$2,551
Per acre-foot	147	170	321	495	729
Value of water delivered, one-year only					
Per acre-foot	9	10	19	30	44

Source: Faux and Perry (1999).

Table 4 also shows the value of water as the value per acre-foot. The value of perennial access to one acre-foot of water ranges from $147 to $729, depending on the Land Class. If the water is available for a single year only, its value ranges from $9 to $44 per acre-foot. These values generally coincide with the prices the Oregon Water Trust has paid farmers and ranchers to leave water in streams in Eastern Oregon. For a one-year water lease, the Trust has paid an average price of $20 per acre-foot. To purchase a permanent water right, the Trust has paid from $103 to $154 per acre-foot for water that otherwise would have irrigated pasture, from $67 to $291 per acre-foot of water that would have irrigated hay, and $367 for water that would have irrigated wheat (Oregon Water Trust 1999).

These numbers provide ballpark estimates of the value of water for irrigation in the Upper Klamath Basin. A review of soil maps indicates that irrigated lands in the northern part of the Basin fall largely into Land Class IV. As one moves south, Land Classes III and II become more prevalent. Thus, having water available permanently for typical land, with soils in Land Class III, would increase its value by about $1,122. Water available for only one year would be worth about $19 per acre-foot, or $76 per acre at the rate of 4 acre-feet per acre.

Recent events in the Basin corroborate the general applicability of the results from the Malheur County study. Over the past several years, for example, irrigated ranch land at the north end of Agency Lake in Klamath County sold for about $700 per acre, to be converted to ecological restoration. More recently, the American Land Conservancy has secured options to purchase 32,000 acres for about $3,000 per acre, plus the appraised value of improvements, if federal funds become available to cover the purchase price (Cole 2001). The market data from Malheur County indicate that negotiated values for irrigated land would range from about $3,000 per acre for land in Class I, to about $900 for Class V (Faux and Perry 1999).

These examples reinforce the notion that the numbers in Table 4 are only roughly applicable to lands in the Klamath Basin. Actual prices would vary. Irrigators in Malheur County apply less water—3.5 feet vs. 4 feet in the Basin for potatoes and 3.7 feet for other crops—and, hence, all else equal, the value per acre-foot should be higher there than in the Basin. In addition, prices for many agricultural commodities grown in the Basin have fallen since the early 1990s, exerting downward pressure on the values of land, water, and other inputs to agricultural production. And, of course, the assertion of tribal claims to water and issues associated with endangered species, water quality, the management of federal wildlife refuges, and other environmental concerns have generated uncertainty about the future availability of water for irrigation in some portions of the Basin. This increasing uncertainty also exerts downward pressure on land and water values.

Other aspects of irrigation demand

Also important is the role water plays in removing waste products from agricultural lands. The demand for irrigation water is tightly linked to agricultural practices that introduce sediment, manure, and farm chemicals into runoff from fields. Potential restrictions on so-called non-point pollution from agricultural fields potentially would lower the demand for irrigation water. Environmental agencies in Oregon and California have not yet defined the assimilative capacity of water bodies in the Basin, and established limits, called Total Maximum Daily Limits (TMDLs) on how much pollution can be introduced to them. Once these are established, restrictions on pollution allowed from agricultural fields potentially would lower the demand for irrigation water.

Or, they might not. Given the current structure of water allocations, reductions in irrigation in one place may lead to increases elsewhere. One farmer, for example may restrict irrigation on one field and increase it elsewhere by increasing the acreage irrigated or switching to a water-intensive crop. Unless there are explicit protections to ensure water stays instream, when one irrigation is reduced on one field, the increment may be used on another, with no net impact on stream flows.

Another important aspect of irrigation demand is the interlocking nature of farms, ranches, and irrigation infrastructure. Irrigation water is delivered to the southern end of the Basin by seven dams, 185 miles of transmission canals, 516 miles of lateral ditch, and 45 pumping plants (Blake et al. 2000). Some or all of the costs of the infrastructure are spread across the irrigators that benefit from it. Retiring some lands from irrigation may leave the others holding the bag, and the increased financial burden may render irrigation infeasible for some or all of them. These interconnections make it more difficult to reduce irrigation on some farms, ranches, or fields without taking into account the implications for the neighbors.

Lifestyle and heritage values

Farm-ranch demand for water has more dimensions than the commercial aspects described above. Foremost among these are the values farm and ranch families place on maintaining their lifestyle and, in many cases, on sustaining the fruits of past labors by their ancestors. These values generally represent strongly held beliefs and preferences that cannot be represented in the financial performance of commercial farms. Indeed, farm and ranch families often forgo higher incomes in other professions and other locations to maintain their lifestyle.

The lifestyle and heritage values associated with working the land, growing food, and raising livestock are powerful components of the farm and ranch demands for water in the Basin, components that are not reflected in the accounting numbers regarding net farm revenues and asset values.

The lifestyle values are enhanced in many instances by history. Many families can trace their roots in the Basin to efforts by the federal government to attract homesteaders to the region and the development of the Klamath Project to provide inexpensive water for irrigation. Farmers and ranchers with a tribal heritage, of course, have a much longer attachment to the land. For these families (and, similarly, for those who have farmed or ranched in the Basin for shorter periods), the prospect of losing access to irrigation water represents not just the failure of a commercial enterprise, but also the wrenching termination of obligations one generation feels to maintain the farm or ranch as a memorial for those that came before and an endowment for those that will come in the future.

For most, perhaps all, farm and ranch families, these lifestyle and heritage values lie beyond the bounds of normal concepts of valuation and pricing associated with commercial activities. In this regard, they are similar to the values that some conservationists ascribe to protecting some aspects of the environment, or some groups attribute to preserving their connections to their ethnic or cultural roots. The lifestyle and heritage values associated with working the land, growing food, and raising livestock are powerful components of the farm and ranch demands for water in the Basin, components that are not reflected in the accounting numbers regarding net farm revenues and asset values.

TYPE 2 DEMAND: MUNICIPAL-INDUSTRIAL USES

Municipal-industrial water users in the Upper Klamath Basin rely primarily on groundwater and withdraw little surface water, but use streams to dilute and remove waste products. The 1990 survey of water use by the U.S. Geological Survey (Broad and Collins 1996) found that, in the Oregon portion of the Basin, municipal utilities and self-supplied residential users relied solely on groundwater, and self-supplied commercial users—distributed almost evenly in the sub-basin surrounding Klamath Lake and the Lost River sub-basin—withdrew 43,000 acre-feet of surface water. Self-supplied industrial users withdrew less than 2,000 acre-feet.

Industrial plants use water for cooling, to remove waste products, or to be incorporated into the manufacturing process. The Basin also has a unique, industrial demand, associated with the harvest and processing of algae growing in Upper Klamath Lake.

Waste-disposal demand

Given the predominant use of groundwater supplies, the increasing competition for surface water probably will not constrict supplies for municipal-industrial users. It will, however, affect the ability of municipal-industrial users to dispose of waste products in the Basin's streams. Historically, restrictions on water polluters have fallen more heavily on cities and industries, where the waste products flow from a pipe into a stream, than on farmers and others, whose waste flows into streams from dispersed, hard-to-identify sources. There are indications that this unequal treatment of polluters will continue. It will certainly be the case if ongoing efforts to develop plans for controlling agricultural pollution do not require a significant change from the current agricultural practices.

Some observers of the process that will generate the agricultural plans for the Oregon portion of the Basin—called a 1010 plan after the number of the legislative bill that underlies them—fear the plans will do little more than endorse continuation of the status quo. If so, and the plan goes into effect unchallenged, then the ratepayers and taxpayers supporting the sanitary- and stormwater-sewage systems in and around Klamath Falls can anticipate they may have to bear additional costs to rollback current pollution levels in the Klamath River.

Matters could become worse for these taxpayers and ratepayers if new urban-industrial growth materializes and developers do not fully pay the costs they add to the sanitary- and stormwater-sewage systems.

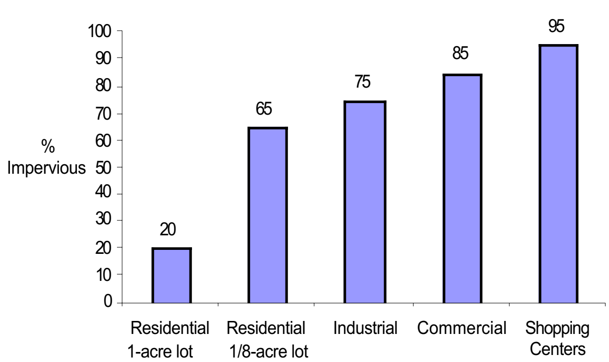
There exists considerable controversy over the extent to which new urban and industrial development pays for the costs it imposes on existing infrastructure. Many students of the controversy believe new development does not pay for the costs it imposes. Such development can materialize quickly and with little warning. A new plant to manufacture silicon chips in Eugene, for example, has used more than 1 million gallons of water per day, or more than 1,200 acre-feet per year. The plant was unforeseen until just before it was built.

Impervious surfaces

A major component of the municipal-industrial demand for water arises from the use of streams to absorb and carry away the runoff from impervious surfaces. Pavement, roads, roofs, and other barriers that water cannot penetrate accelerate storm runoff and increase the flow of pollutants into streams. Hence, the greater the amount of impervious surfaces in a watershed, the lower the health of its streams (Horner and May 1998).

The impacts of municipal development can be dramatic. Studies near Puget Sound, for example, show that, in natural forests, less than one percent of rainfall becomes surface runoff, 33 percent becomes groundwater, 21 percent becomes interflow (the water that travels just below the surface), and 46 percent returns to the atmosphere via evapotranspiration. In contrast, on impervious surfaces 84 percent of the rainfall becomes surface runoff, none becomes groundwater or interflow, and 16 percent is evapotranspirated (Beyerlein and Brascher 1998). Almost all of the pollution deposited on impervious surfaces that is not removed by wind, decay, or street cleaning will end up in surface waters (Novotny and Chester 1981).

Figure 2: Impervious Surface by Land Use



Source: Arnold and Gibbons (1996)

The amount of impervious surfaces varies with land use. Although low-density residential subdivisions have the lowest impervious surface per lot, their longer roads, driveways, and sidewalks generally create more overall impervious surface than cluster-style housing (Arnold and Gibbons 1996).

Urban lands deliver lots of pollution harmful to fish and other aquatic species. Studies in the Willamette

Basin, for example, show that, per acre, urban sites deliver the greatest amount of suspended sediment to streams (U.S. General Accounting Office 1998). Construction activities are especially large generators of sediment, producing 59,670 pounds of sediment per acre per year while general urban activities produce 27–44 pounds per acre (Novotny and Chester 1981).

Urban runoff also contains high concentrations of pesticides. In the Puget Sound Basin, where the region's most extensive studies have been completed, more types of pesticides were detected in urban streams than in agricultural areas. Pesticides used on lawns and gardens often end up in streams, where concentrations frequently exceed water-quality standards (Voss et al. 1999).

TYPE 3 DEMAND: ECOLOGICAL-SERVICE USES

Many Americans—both local residents and those who live elsewhere—place economic values on a multitude of services provided by the ecosystem of the Upper Klamath Basin. Tribal members and others depend on the ecosystem for subsistence. Recreational hunters and anglers spend money to pursue waterfowl and fish. The economic values of the Basin's ecosystem services also manifest themselves when they influence the locational decisions of households and firms. Other economic values are less apparent, but no less important, and represent the intrinsic worth of individual species, clean water, attractive scenery, and natural habitats. Even more difficult to see, but perhaps most important of all, are the fundamental contributions the Basin's ecosystem makes to sustaining human life on this planet, by supporting the various processes, such as the circulation of water, oxygen, and carbon, and maintaining the web of life that provided the conditions needed for the evolution of humans.

Productivity of the Basin's ecosystem

The ecological productivity of the Upper Klamath Basin is significantly below its potential, as indicated by these facts:

- At one time, there were about 185,000 acres of marshlands and shallow lakes at the south end of the Basin. Such lands are among the most productive biologically, and reductions in their productivity can have repercussions far beyond their boundaries. Over the past century or so, 80 percent of these marshlands and shallow lakes were drained, and only 36,000 remain.
- Although they have recently recovered somewhat, in the latter half of the past century, the numbers of waterfowl residing in or visiting the Basin fell to about 15 percent of what they had been. The reductions probably stem from numerous factors, many of which fall outside the Basin, but reductions in the Basin's productivity appear to be a major contributing cause.
- Dams prevent spawning salmon from reaching the Upper Klamath Basin.
- Approximately one-quarter of the vertebrate species found in the Basin are of concern: categorized as threatened, endangered, or sensitive; or considered species of concern to state or federal agencies.

Blake, Blake and Kittredge (2000)

Direct use of ecological services

Through hunting, fishing, sightseeing, and other activities, hundreds of thousands of people—perhaps millions—consume services provided by the Basin's ecosystem. Although there is no summation of the values of these services, the data for several variables show their general importance.

Table 5: Estimates of Salmon Value

Component of Value	Value Estimate ($1998)
Recreational Fishing	$200 per fish
Commercial Fishing	$5–70 per fish

Source: Niemi, Whitelaw, Gall, and Fifield (1999) and Radtke and Davis (1995).

The timing, levels, and qualities of water flowing from the Basin down the Klamath River influence the river's production of salmon. Prior to the listing of suckers and coho salmon under the Endangered Species Act, about 500,000 acre-feet of water were used for fish and wildlife each year. Now 900,000 acre-feet are needed to meet minimum flows for the fish (Barnard 2000). The data in Table 5 show that, if salmon populations were increased, each additional fish caught by anglers would be worth about $200. Each additional fish caught by the commercial fishing industry would be worth $5-70. The data in Table 6 show that increasing salmon populations can increase jobs, with each 1,000 fish caught commercially generating 1.5 jobs. About 4 jobs would be supported if they were caught recreationally. In the latter case, anglers would spend almost $80,000. What anglers spend to catch fish represents only part of the salmon's total value, though. The total value of the fish to the anglers would be worth almost $110,000 more than the anglers would spend to catch them. Economists call this additional worth the anglers' consumer surplus.

Table 6: Potential Impacts from Increased Fish Catch

	Per 1,000 Fish
If Fish Are Caught Commercially…	
Jobs	1.5
If Fish Are Caught Recreationally…	
Jobs	4.0
Anglers' Expenditures[a]	$79,510
Anglers' Consumer Surplus[a,b]	$108,900

[a] Values in 1998 dollars. [b] Value of fish to anglers minus costs of catching them.

The Tulelake National Wildlife Refuge accommodates about 200,000 recreational visitors each year and a smaller number visit the Lower Klamath Refuge (Blake et al. 2000). Most of these visitors come to view waterfowl and other wildlife. About 10,000 are hunters. Table 7, drawing on analyses completed by Forest Service economists (Haynes and Horne 1997), shows the estimated values for these and other types of recreational services provided by the Basin's ecosystem. On average, recreationists are willing to pay more than $30 for the opportunity to spend a day viewing wildlife, so that the total value of such services provided by the Tulelake National Wildlife Refuge to

200,000 visitors annually is about $6 million. Each day of hunting has an estimated value of about $47, and the total value of the 10,000 hunting visitations is about $470,000 annually. Other sightseers and hunters derive benefits elsewhere, as the waterfowl migrate.

Opportunities for fishing are especially valuable recreational services provided by the ecosystem, with each person-day of fishing worth almost $55. Recreation opportunities in natural settings are more valuable than those in areas exhibiting human disturbance. Any activity taking place in a wilderness setting is worth almost $36 more per person-day. Haynes and Horne concluded that, over the next 45 years, recreational opportunities will become far more valuable, relative to the production of agricultural and timber commodities.

Water flowing from the Upper Basin also is important for its ability to generate electricity as it passes through dams on the Klamath River. By one estimate from the dams' owner, every acre-foot of water passing through the dams generates 25 kilowatt-hours of electricity, worth about 3–10 cents each (Zuckerman 2001). Data in Table 2 indicate that the irrigation system in the Oregon portion of the Basin consumes 371,000 acre-feet and incurs conveyance losses of 217,000 acre-feet per year. Some of the conveyance loss probably returns to the river, so the net impact on flows is unknown, but the data indicate that, perhaps, the overall irrigation system in some years reduces flows by 500,000 acre-feet. If this water were allowed, instead, to pass down river, it would generate power worth about $0.4–1.2 million.

Ecological services and household-location decisions

Over the past 20 years it has become increasingly apparent that the quality of an area's natural environment can significantly affect the locational decisions of households and firms. This is especially true in Oregon and the Upper Klamath Basin. A 1998 survey of new immigrants to Oregon found that, when asked why they moved here, 44 percent cited the state's quality of life. The only response with a (slightly) higher percentage was to be near family and friends. In the subregion comprising Klamath and Lake Counties, 48 percent of the recent immigrants cited quality of life as a reason for moving here. This percentage was higher than elsewhere in Oregon, except for the

Table 7: Value of Recreational Services

	$ per Person-Day
Camping	$9.27
Day use	9.27
Fishing	54.66
Hunting	46.71
Motor boating	2.39
Motor viewing	4.78
Non-motor boating	3.59
Trail use	7.21
Viewing wildlife	31.15
Wilderness[a]	35.55

[a] Additional value when activity takes place in wilderness.

Source: Haynes and Horne (1997).

area around Bend and the southwestern corner of the state.

The ability of a pleasant natural environment to attract households has important economic implications. In general, people living in a place with a high quality of life will accept lower wages and still feel they are better off than living elsewhere. A 1991 study, for example, found that the behavior of workers in Oregon indicated they, on average, would have to be paid more than 10 percent higher wages to live elsewhere (Greenwood et al. 1991). This is important for workers, firms, and communities because, if firms can incur lower wage costs, they can be more competitive against firms in other regions or countries. In effect, the environment subsidizes local firms' labor costs and profits.

It is impossible at this time to estimate the quality-of-life premium attributable to the Basin's water-related resources. It is clear, though, that many of the Basin's most outstanding natural-resource amenities are water-related. Hence, it seems safe to conclude that changes in the quality, timing, and levels of flows in the Basin can have a significant influence on the region's economic competitiveness. Imagine, for instance, how the public's perception of the Basin's natural-resource amenities would change if barriers to salmon navigation were overcome and chinook again spawned on the Sprague, Williamson, and other rivers.

In sum, the behavior of households—those who move to the Basin and those who remain—provides indirect, but compelling evidence of the economic importance of the Basin's natural resources.

Intrinsic values

We use the term, intrinsic value, to refer to a set of different types of economic value attributable to the Basin's water and related resources. Some of this value stems from the spiritual reassurance some people associate with these resources. Also important are the values some people place on knowing that the Basin and its species exist, even though they have no intention of visiting the place. Still others value the resources and are willing to pay to protect them because they want to ensure that the resources are available to their children and future generations. Oregon and Washington residents, for example, say they are willing to pay about $30-97 per household, per year to protect salmon (Olsen et al. 1991; U.S. Department of Commerce 1998; Washington Department of Fish and Wildlife 1996).

As with many of the other aspects of the value of the Basin's ecological services, it is impossible at this time to quantify their intrinsic values. Indeed, many believe that the intrinsic values are so fundamental and large that the very concept of quantification is rendered impotent. It is important to recognize, though, that although skeptics sometimes downplay intrinsic values as being too ethereal to be economically relevant, they can come into play with the force of a sledgehammer. Imagine, for example, the economic forces that might come into play if the national evening news carried stories and photos of an environmental catastrophe in the Basin, such as massive poisoning of Gold eagles. In such events, public outcry rooted in intrinsic values can move political and economic mountains.

Lifestyle and heritage values associated with ecological services

Demands for the ecological services supported by the Basin's water and related resources include the values that many people place on maintaining a lifestyle dependent on those services and, in many cases, on connecting to a lifestyle enjoyed by their ancestors. Notable among this group are the members of the Indian tribes, in both the Upper and Lower parts of the overall Klamath Basin. The tribes of the Upper Basin once harvested thousands of sucker fish that are now listed as endangered, as well as other foods and materials from the area's wetlands and streams, while those in the Lower Basin once harvested thousands of salmon from the lower Klamath River. The availability of the fish and other products underlay traditional economies and cultures.

The supplies of fish and other products were dependent on the Basin's ecological services: the ability of its natural ecosystem to meet the habitat needs, including reliable amounts of clean water, of fish and other species. These services have been severely curtailed by the diking and drainage of wetlands, the withdrawal of water from streams and lakes, the introduction of pesticides and other contaminants to surface water, and numerous, other activities.

The curtailment of natural ecological services also has affected the lifestyle and heritage values of groups other than tribal members. These include communities in the Lower Basin and along the Pacific coast built around the commercial salmon fishing industry. These communities have undergone extensive change as the supply of salmon from the Klamath Basin has dwindled. Also affected are those with connections to other lifestyle patterns, such as watching and hunting birds, that evolved in the context of the Basin's once-abundant, but now depleted, natural resources.

In many instances, these lifestyle and heritage values compete head-on with those of the farmers, ranchers, and others who have benefited from the actions that contributed to the diminution of the Basin's ecological services. This competition is especially apparent for the Yurok Tribe, whose traditional homeland lies at the mouth of the

Klamath River, and the families of commercial fishers in coastal communities. For decades they have seen their traditional lifestyles and their economic and cultural connection to past generations injured by activities, such as the Bureau of Reclamation's Klamath Project, that promoted the establishment of new lifestyles and heritages associated with irrigated farming and life in the communities of the Upper Basin. Recent efforts by the Yuroks and coastal groups to reverse this injury have, in turn, been seen by many in the Upper Basin as a threat to their traditional, farm-based lifestyles.

In other instances, the competition among lifestyle and heritage values is more obscure. Many residents of the Upper Basin, for example, express a desire for both the lifestyle derived from the Basin's ecological services and the lifestyle derived from decades of irrigated farming that has impaired these services.

The competition for water and related resources stemming from lifestyle and heritage values associated with the Basin's ecological services generally cannot be captured in the financial performance of commercial enterprises, but it is no less important for the difficulty in being quantified. To date, there seems to be no mechanisms, such as prices and markets, for accommodating this aspect of competition over natural resources, in the Basin or elsewhere. Hence, it seems that this aspect of the competition will play out in legislative battles, legal contests, and media campaigns. Although some view activities in these arenas as sideshows to, or even a countervention of competition, they more properly constitute the very essence of competition until our society can develop different mechanisms for accommodating and resolving differences in lifestyle and heritage values. We pursue these issues further in the next two chapters.

TYPE 4 DEMAND: THIRD-PARTY PREFERENCES

Many people not immediately engaged in the struggle over how the Basin's water and related resources should be managed, nonetheless have a significant interest in how the struggle is conducted and in how it plays out. These third-part interests extend throughout the country (and beyond): workers in the Midwest who manufacture farm equipment for use in the Basin; farmers in other regions who compete with those in the Basin; workers in the recreation industry affected by the Basin's impact on waterfowl populations; and countless others.

For this exercise, though, we focus closer to home and consider third-party interests in terms of how alternative outcomes from the competition for water would affect the local economy. To facilitate the discussion, we frame it in terms of the potential local economic impacts of shifting water from farm-ranch uses to meeting the demands for ecological services, and observe that such a shift would have both negative and positive impacts on the local economy. Symmatry dictates that the impacts would be reversed if water resources were shifted from the ecosystem to farm-ranch uses.

As we assemble the discussion, we fully recognize that no discussion of the potential economic impacts of changes in water use can occur entirely outside the Basin's this context: the Basin's economy has endured tough times during the past two decades and many attribute the problems to past decisions that withdrew water, timber, and other natural resources from established industries. The prospect of further withdrawals is seen by many as yet another assault on industries and local communities that have been punished and demonized for extracting jobs and incomes from the use of natural resources.

We have an alternative explanation for what has happened to the Basin's economy. Our purpose here, though, is not to debate these different views of the Basin's economic history. Hence, for those who might be interested in them, in the appendix we offer a brief summary of our views. Here, however, we keep our eyes pointed forward, consider the possibility that water might be transferred from farm-ranch use, and trace through the potential negative and positive impacts on the local economy that might result.

Potential negative impacts of irrigation reductions on the local economy

Reductions in irrigation would lead to reductions in farm production, employment, and income. These, in turn, would have ripple effects through the local economy as farmers spend less on seeds, fertilizers, and other inputs; the processors of farm produce have less demand for their services; and farm families and farm workers have less income to spend on consumer items. Most of these impacts would materialize in the private sector, but the public sector also would be affected as the reductions in irrigation-based land values and overall economic activity resulted in lower tax payments and, perhaps, in higher demands for social services associated with unemployment, and other problems that often materialize when an economic sector contracts.

The data in Table 8 provide a rough foundation for seeing the general magnitude of the potential impacts. They rest on two critical assumptions: (1) that absent a reduction in irrigation the agricultural sector of the economy would remain the same as reported by the 1997 census; and (2) that a 10 percent reduction in irrigation withdrawals in Klamath County would lead to a 10 percent reduction in all relevant variables. Thus, the number of irrigated acres would decline by 24,320 acres. We assume that all this reduction would occur on farms with sales of at least $10,000 in 1997, and be concentrated on a few farms, which consequently ceased operations, so the county would see the number of farms reduced by 58. About 180 farm workers would lose their jobs. Farmers' expenditures, all of which we assume would occur locally, would decline by almost $8 million, property-tax payments would decline by $160,000 because of declines in farm values, and net farm income would decline by more than $2 million.

As a rough approximation, the total impact on the local economy would be roughly double the initial, on-farm impact. Thus, since 58 farmers and 178 farm workers would lose their on-farm employment, the total job loss would be about 472. The total decline in incomes in the county would be about $6 million, double the sum of the decline in farm payroll and farmers' net cash income. Property-tax payments would decline about $320,000.

Although the actual, future reduction in irrigation withdrawals might be larger than in this illustration (indeed, farmers already have committed to options with the American Land Conservancy that would retire 32,000 acres of farmland), the remainder of the assumptions in the illustration represent extreme, worst-case conditions that would not materialize. This fact is so often overlooked in discussions of negative impacts of environmental activities that we repeat it: all the assumptions, but for the percentage reduction in irrigation, represent extreme, worst-case conditions that would not materialize. This is so because the assumptions describe an economy frozen in time, with the various affected individuals, firms, and communities unable to adjust to the contraction in irrigation.

Table 8: A Worst-Case Illustration of the On-Farm Impacts of a Hypothetical 10 Percent Reduction in Irrigation Withdrawals in Klamath County

	Total[a]	10 Percent Reduction
Water withdrawals (acre feet)	900,600	90,060
Irrigated acres[b]	243,205	24,320
Farms w/ sales of at least $10,000	576	58
Hired farm workers	1,779	178
Farm payroll	$9,745,000	$974,500
Farm sales	$99 mil.	$9.9 mil.
Farm expenses	$76 mil.	$7.6 mil.
Property taxes	$1.6 mil.	$160,000
Net cash income	$21 mil.	$2.1 mil.

[a] Total in 1997.

[b] Total irrigated for all farms, most of which occurs on those with sales of at least $10,000.

Source: ECONorthwest, with data from U.S. Department of Agriculture (1999b).

In reality, most of these parties would react quickly and with considerable effectiveness. Hence, the actual negative economic impacts on the local economy would be mitigated by these factors:

(1) Future reductions in irrigation might be spread over many farms, with each reducing production on small acreage, and no farms would cease operations. Alternatively, the irrigation reductions might be concentrated among those farms that have exhibited negative net earnings.

(2) Farmers are among the most innovative of U.S. business managers in adapting to changing conditions and it is reasonable to anticipate that, with an X percent reduction in irrigation, the impacts on production, employment, and income would be less than X percent.

(3) Factors other than the competition for water are reducing the economic viability of many farms, and, if these trends continue, the economic impacts of curtailing irrigation in the future will be smaller than those that would materialize today. Data from the 1997 census, reported in Tables 1 and 3, and discussed earlier, show that:

    - 46 percent of all farms (and ranches) in Klamath County had sales of less than $10,000.
    - Of those that exceeded this threshold, 37 percent had net losses averaging $19,139.

    The factors leading to these outcomes and worse in ensuing years include falling prices for many farm products, and increases in the costs of farm inputs, such as electricity and fertilizers. Furthermore, changes in the structure of the food-and-fiber industry are squeezing farmers' earnings. Reductions in the number of food processors, for example, reduces farmers' bargaining power over product prices, and some processors have assumed responsibility for harvesting crops, foreclosing opportunities for farmers to earn income from harvesting.

(4) National statistics indicate that most workers displaced from jobs would find replacement jobs within a few months, although some might have to relocate to another county to do so. Pay levels at many replacement jobs would exceed the pay levels at the jobs that were lost (Helwig 2001).

(5) Evidence from the Midwest indicates that farmers and their families who exit from farming after a prolonged period of financial stress experience increases in income, decreases in stress, and improvements in their overall quality of life (Lorenz et al. 2000).

(6) Most of the business activity indirectly affected by a curtailment of irrigation would adjust quickly. Especially during a period when the farm sector is contracting nationally, many vendors selling to farms are looking to diversify their business. As the local and regional economies experience growth, the growth may offset and overwhelm the impacts a reduction in irrigated farming might have on retail and service sectors.

Given these factors, it is reasonable to anticipate that, if the assumed level of irrigation curtailment occurred, the overall economic effects rippling through the local economy would be smaller—markedly smaller—than those indicated by the illustration above. Furthermore, whatever the initial negative impacts, they will become smaller over time.

These conclusions are reinforced by the data in Table 9, showing the farm sector's share of Klamath County's overall employment and income. The data indicate that the farm sector's role in the overall economy has been declining for years in the Upper Basin, as it has throughout the U.S. By 1998, the employment it provided proprietors and farm workers constituted 10 percent of the county's total employment, but, because these were low-income jobs, the sector accounted for only one-half of one percent of total income in the county. Proprietors, in the aggregate, lost about $3 million, while farm workers earned $9 million, or less than $4,400 each. The size of the sector's contribution to the total economy indicates that the bulk of the economy is not closely linked to the farm sector and, hence, a reduction in irrigation would not generate large, negative ripple effects in the overall economy. The economy-wide effects would be lessened if the reduction were phased in slowly and diminish over time.

Table 9: The Farm Sector's Share of Total Employment and Income in Klamath County

	1970	1980	1990	1998
Employment	14%	11%	11%	10% [a]
Income	8%	6%	1%	0.5% [b]

Source: ECONorthwest with data from the Bureau of Economic analysis.

[a] Proprietors constitute 4% and employees 6%. Total employment (including proprietors) in Klamath County was 32,234.

[b] Reflects the net farm-sector income, comprised of earnings by employees of $9 million and a loss of $3 million by proprietors. Total income for Klamath County was $1.25 billion.

The data and discussion associated with Table 4, earlier in this chapter, indicates that potential impacts of irrigation reductions on the public sector also should be limited, especially for temporary reductions. Market data from Malheur County indicate that landowners attribute a value of about $76 per acre to having (or losing) access to water for one year on acreage with Land Class III soils.

Please read this paragraph carefully. One should not interpret these conclusions about the limited, potential impacts on the overall economy to mean that all the affected individuals, families, firms and communities would go through the transition unscathed. The history of similar transitions indicates that some may be severely affected. By focusing on the overall economic ramifications of potential reductions in irrigation, we by no means discount the impacts on individuals and their families that can accompany losing a job or curtailing farming operations. They can be gut-wrenching. Experience in other settings shows that there may be much that can be done to help individuals and families avoid or alleviate the impacts of losing jobs and incomes. An examination of these issues, however, lies outside the scope of this report.

Potential positive impacts of irrigation reductions on the local economy

The potential negative impacts from curtailing irrigation are far more familiar and materialize far more rapidly than the potential positive impacts from using more water to produce ecological services. Residents of the area have seen several contractions in the agricultural industry over the past two decades. The linkages connecting declines in farm-ranch output and incomes with other sectors of the economy are highly visible and the people in those sectors can readily identify their third-party interest in how water-management decisions affecting irrigation also affect them.

The positive impacts on the economy stemming from increased production of ecological services are harder to see, but this does not mean they are unimportant. Reversing the allocation of water to farm-ranch uses represents a fundamental change in the management of an important resource. As with many fundamental economic changes, the future becomes harder to see than the past. Indirect evidence indicates, however, that future improvements in the ecological services derived from the Basin's water could yield substantial increases in overall levels of jobs and incomes in the Basin over the foreseeable future.

Water and related resources—such as waterfowl, fish, and riparian (streamside) vegetation—boost the Basin's economy by providing recreational opportunities, scenic vistas, healthy environments, and other amenities that contribute directly to the economic well-being of people who have access to them. In economic parlance, these are known as consumption amenities. Their contribution to consumers' well-being is important in its own right, but they also influence the locational decisions of households and firms.

Economists' explanation of why consumption amenities can influence locations revolves around the concept of consumer surplus. Whenever a consumer derives benefits (increases in well-being) from a good or service that exceed the costs the consumer pays to obtain it, the net benefit represents a net increase in well-being. This net increment is called consumer surplus. In general, consumption amenities offer the prospect of positive consumer surplus. The nearer that people live to such amenities, the better their access, and the lower their cost of taking advantage of them. Thus, consumers can increase their consumer surplus—their economic well-being—by living near places with recreational opportunities, wildlife viewing, and other amenities.

Whitelaw and Niemi (1989) have likened this consumer surplus to a *second paycheck* residents receive from living in a place where they have easy access to amenities, so that the total welfare of residents within commuting distance of the amenities is the sum of this second paycheck plus the purchasing power of their money income. The size of the second paycheck affects behavior in the local and regional economies by influencing household demand for residential location. All else equal, if amenities in a region improve, people will tend to move to that region. Repercussions then reverberate throughout the economy, in: the make-up of the population; the composition of firms pursuing new residents as workers and/or consumers; and the price of land and housing.

Figure 3: The Importance of Ecological Services to the Local Economy

The quality of life in the Basin influences the location of households and firms

Almost half of recent immigrants to the Basin indicate they moved here to take advantage of the quality of life. On average, middle-aged persons moving to Oregon primarily to take advantage of the quality of life accepted a reduction in income of more than $10,000 to do so (Judson et al. 1999). Businesses locate to take advantage of these trends.

↓

Ecological services derived from water are important components of the quality of life in the Basin

Of all resource-related recreational activities, fishing and wildlife-viewing have the highest amenity values (Haynes and Horne 1997). A survey that included recent immigrants to eastern Oregon found that nearly 40 percent said the protection of water, watersheds, and ecosystems was the most important land-use issue for them. Fewer than six percent felt grazing and ranching was more important.

↓

The quantity and quality of water in streams matters

The amenity values associated with rivers increase as water-quality improves and as streamflow increases, at least until flows reach high levels (Brown et al. 1990; Carson and Mitchell 1993).

↓

Rural counties with a high quality of life experience faster growth in jobs and incomes

Numerous studies show that faster economic growth occurs in counties with mountains, sunshine, bodies of water, and public access to undeveloped lands (Cromartie and Wardwell 1999; Drabenstott and Smith 1996; and Southwick Associates 2000).

↓

The quality-of-life influence on the Basin's economy already exists and is likely to grow

Analyses by the U.S. Dept. of Agriculture show the linkage between Klamath County's high level of natural amenities and its ability to attract both entrepreneurs who are critically important to the start-up of small businesses, and residents with investment capital (Nelson 1999). Demand for high-quality natural resources will increase as the nation's education, incomes, and household mobility increase. Hence, as the nation's economy grows, the demand for places with a quality of life that includes high-quality natural resources will grow even faster.

Several types of evidence indicate that increasing the production of water-related consumer amenities in the Basin would increase the Basin's ability to attract and retain skilled workers, as well as retirees and others who have non-labor sources of income that can boost the local economy. Furthermore, as workers and others are attracted more strongly to the area, firms in a wide range of economic sectors could be attracted to the Basin to capitalize on the larger pools of workers and consumers. These pieces of evidence, briefly summarized in Figure 3, reinforce the notion that most of the Basin's residents and businesses have an economic interest in improving the Basin's water-related consumer amenities, because doing so would boost the local economy.

The key piece of this evidence is that households in the U.S. increasingly place a premium on living in places with natural-resource amenities. Numerous studies demonstrate that the ability of rural areas to attract workers, investors, and others is the key determinant of economic growth (Cromartie and Nord 1996; Drabenstott and Smith 1996). These same relationships are at work in Eastern Oregon. Deschutes County for example, arguably has the most attractive amenities in Eastern Oregon (perhaps, the entire state), and its population growth averaged 4.4 percent annually during the 1990s, whereas the Eastern Oregon counties grew 1.9 percent and the state as a whole grew 1.7 percent (Columbia Basin Consultants 2000).

The Upper Klamath Basin is not immune to these forces and trends, even though it has lagged behind Deschutes County and other areas that have experienced strong amenity-driven growth during the past decade or so. Its population growth averaged 1.1 percent during the 1990s. Nonetheless, studies of economic-development patterns in the West have concluded that it possesses a high-enough level of natural-resource amenities that similar growth seems almost certain in the future (Cromartie and Wardwell 1999; Nelson 1999).

Resource amenities, of course, are not enough, by themselves, to guarantee accelerated economic growth. Deschutes County benefits also from rapid transportation connections with metropolitan centers, as well as diverse social and cultural amenities. Growth also has been stimulated by timely private investments, such as Sun River and Black Butte Ranch, that capitalized on the county's amenities.

In the Upper Klamath Basin, the mix is different, but not incomparable. The mountains may not be as spectacular as those of Deschutes County and the distances to Portland are longer, but the Basin has more surface water, the Oregon Institute of Technology, and optic fiber trunk lines. This set of circumstances creates an opportunity for the Basin not to replicate what has happened to its northern neighbor but to develop its own economic niche. The experiences of Deschutes County and other counties throughout the West make it clear that, to capitalize on this opportunity, the Basin's residents must enhance and protect their natural-resource assets, thereby increasing the Basin's attractiveness to skilled workers, persons possessing wealth and investment capital, and businesses seeking to take advantage of the resulting skilled workforce, consumer market, and investment pool. If they do not take these actions, instead allowing the resources to become more degraded, they must expect that the Basin's economic future will follow a different path. It is the choice among these options that draws in the third-party interests of workers, businesses, taxpayers, and others who have little direct involvement in water-resource issues, but a big stake in how these issues are resolved.

REFLECTIONS

Looking through economic lenses at the conflict over the Basin's water resources offers important insights both for understanding the conflict and for investigating options for responding to it. Americans have a long history with competition and generally espouse policies and actions resulting in the allocation of scarce resources away from lower-value demands to meet those demands that place the greatest value on them. By this standard, there should be a considerable shift of water away from irrigation and toward the production of ecological services, such as clean water, recreational opportunities, and healthy ecosystems capable of diminishing the threat of extinction currently facing heightened risk of extinction.

The evidence supporting this conclusion is powerful. Historically dominant uses of water resources, for irrigation and waste removal, are not as important economically as they once were. This statement is not intended in any way to disparage these uses or those who participate in them, but, instead, to draw the economic conclusions inherent in consolidation of the agricultural industry, reduced farm incomes, and tighter regulations to restore clean water.

At the same time, demands for ecological services, virtually unheard of two decades ago, have emerged, hand-in-glove, as Americans—better educated, wealthier, and more mobile—express a growing desire to live, work, and play in areas with high-quality natural environments. At the same time, explosive growth in knowledge about the status of natural environments revealed that many of them were seriously degraded and getting more so. Through their actions and in numerous public surveys, the American public expresses high intrinsic values on natural environments.

With increasing demand and decreasing supply, the values of ecological services are growing exponentially. Values are especially

In short, there is an opportunity for the Basin to transform itself into one of the growing number of communities around the West where exceptional natural environments converge with powerful economic creativity. The potential is just that, of course; there is no guarantee it will materialize. With the opportunity for economic transformation and growth, however, come some substantial challenges. Such a transformation of the Basin's economy would bring both good and bad. We encourage the community leaders of the Basin to recognize that the transformation has already begun. It is not too soon to learn from communities that have faced similar transformation and initiate steps to enhance the good things and diminish the bad things that transformation of the economy can bring.

high in places—such as the Central Oregon—where the amenities are exceptional and the access from metropolitan centers is good. The Upper Klamath Basin is in a somewhat different league. Here, the access to metropolitan centers is not as good (though it recently got better with the connection of fiber-optic cables). And, although the current availability of amenities is good, the potential far exceeds what now exists. Waterfowl populations, for example, are high, compared with other locations, but low, compared with historical levels. The Basin has water resources and a rich biodiversity unique for a desert environment, but water quality in streams is frequently poor and one-quarter of the naturally-occurring vertebrate species have been flagged for concern about declining populations and threats to habitat.

In short, there is an opportunity for the Basin to transform itself into one of the growing number of communities around the West where exceptional natural environments converge with powerful economic creativity. The potential is just that, of course; there is no guarantee it will materialize. With such transformations occurring nearby, however—in Ashland, Bend-Redmond, and the Willamette Valley—it seems reasonable to anticipate that the economic pressure to do so will build.

With the opportunity for economic transformation and growth, however, come some substantial challenges. Such a transformation of the Basin's economy would bring both good and bad. Some workers, families, landowners, and firms would benefit, others would not, and many would have a mixed experience. For every proud developer of a new ranchette, with accompanying jobs and incomes, others would decry the urban sprawl, and, across the West, communities are struggling with this experience (for an on-going, informed discussion of these issues, see the newspaper, *High Country News*).

We encourage the community leaders of the Basin to recognize that the transformation has already begun—the number of ranchettes grows yearly and momentum associated with the effort to promote the Basin as the Silicon Basin is building. It is not too soon to learn from communities that have faced similar transformation and initiate steps to enhance the good things and diminish the bad things that transformation of the economy can bring.

This competition among different demands for water in the Basin has assumed the characteristics of a standoff between hardline irrigators and hardline environmentalists, in a winner-take-all contest. This, despite the fact that a winner-take-all outcome necessarily means that one side loses all. Or, worse, both sides may lose things they—even the hardliners—share in common. Many irrigators avow a deep commitment to helping endangered species and cleaning up waterways. And, many in the environmental camp would prefer to see lands in agricultural use, as long as the practices are sustainable, rather than developed into urban subdivisions or ranchettes. The challenge—the hope—is to find ways to move toward these shared goals, toward win-win outcomes.

Of course, immediate challenges concern farmers, ranchers, and others whose incomes and livelihoods are linked to current irrigation patterns. Their demands for water are not in any way insignificant, but the fact remains that they are not growing as rapidly as the ecological demands. If water were allocated via market mechanisms, there would be an orderly shift of water from farms and ranches where it is least valuable to instream uses that are most ecologically productive. Moreover, those realizing the ecological benefits would fully compensate those giving up the benefits of using water for irrigation. Alas, things are not so easy.

Irrigators have legal claims to water and some believe these insulate them from the ecological demands. They do, but not entirely. Tribal claims predate the irrigators', and the Endangered Species Act constrains the ability of federal agencies and resources users to degrade the habitat or injure at-risk species. Moreover, as the ecological value of water increases, irrigators will face increasing costs to cope with lawsuits, political maneuvers, and other forms of resistance. At some point, these costs will become unbearable, if not to the farmers and ranchers themselves, then to their political and economic allies.

Conversely, those who prefer using water for ecological purposes also face potentially prohibitive costs of obtaining their objectives. Americans persistently profess support for family farmers and it will be hard for those trying to slash irrigation to overcome this political support. It is reasonable to expect irrigators to dig their heels in more deeply, especially if they believe that, by not doing so, they would lose both the water and the prospect of compensation for their losses. It should be clear from the discussion of farm-ranch demand that those who do most of the irrigating have significant incomes and capital at stake, and they will not give this up lightly.

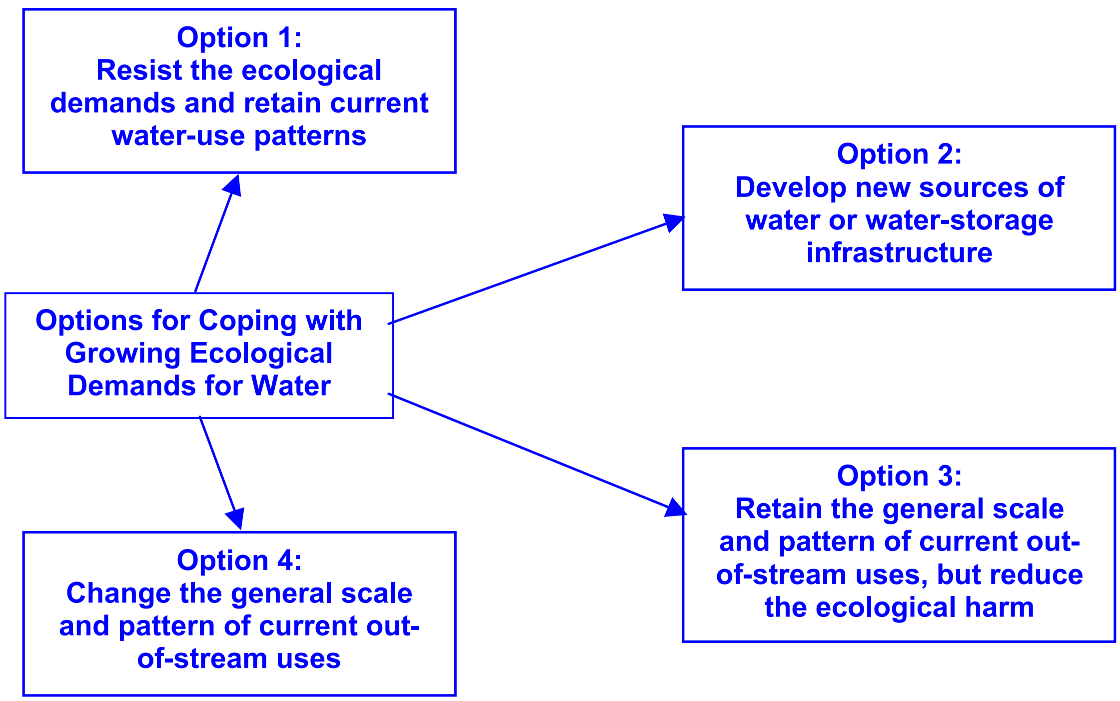
This competition among different demands for water in the Basin has assumed the characteristics of a standoff between hardline irrigators and hardline environmentalists, in a winner-take-all contest. This, despite the fact that a winner-take-all outcome necessarily means that one side loses all. Or, worse, both sides may lose things they—even the hardliners—share in common. Many irrigators avow a deep commitment to helping endangered species and cleaning up waterways. And, many in the environmental camp would prefer to see lands in agricultural use, as long as the practices are sustainable, rather than developed into urban subdivisions or ranchettes.

The challenge—the hope—is to find ways to move toward these shared goals, toward win-win outcomes. In the next chapter we lay out some of the options.

STRATEGIC OPTIONS

In this chapter we briefly discuss the four strategic options, identified in Figure 4, for coping with the increasing ecological demands for water in the Upper Klamath Basin.

Figure 4: Major Strategic Options



The discussion, intended to offer insights into the tradeoffs among the options without becoming tedious, hits only the highlights. We recognize that others have looked more deeply at some issues. Many landowners, for example, have clarified their rights to water for irrigation, while others have initiated organic farming practices. The Klamath Basin Ecosystem Foundation (KBEF), among others, has investigated conservation easements for protecting critical habitats. We encourage readers who find this discussion interesting to seek further information from KBEF, The Nature Conservancy, Oregon Water Trust, and other groups trying to cope with the growing competition for water in a non-adversarial manner.

Option 1: Resist ecological demands

> Defend water rights for current out-of-stream uses.
>
> Defend ability to pollute streams by promoting relaxation and opposing tightening of Clean Water Act, Endangered Species Act, and other laws.
>
> Try to persuade the public that using water out-of-stream is more important than leaving it instream to improve the environment.

It is natural for those with established uses of water to resist new users as they appear. For awhile, at least, this approach can be successful in defending current uses of water from the demands of tribes, environmental groups, and others.

Success, however, can come at considerable cost. Costs include both out-of-pocket expenses and missed opportunities for accommodating new demands in a manner that also benefits old ones. Although out-of-pocket costs are no doubt keenly felt by those fending off competition, the missed opportunities may be more important. Today's agricultural markets are increasingly competitive and producers distracted by water issues can lose markets to more focused competitors elsewhere.

Hence, those with existing water rights may realize real economic benefits from rethinking the consequences of trying to block ecological demands. Dislike of environmental groups may lead an irrigator to reject an opportunity to sell a conservation easement to them, only to face lawsuits that would curtail the irrigation anyway. Or, a municipality might resist pressures to impose land-use regulations that would limit runoff from new developments, but be coerced into taking more expensive corrective measures later.

Omnipresent is the risk that opposing ecological demands may exacerbate them. Failing to protect habitat for a species now may mean the species eventually receives the severe protections of the Endangered Species Act. The recent *Oregon State of the Environment Report 2000* makes it clear that environmental problems in the Basin are extensive and will worsen if economic and population growth occur in the future as they have in the past. Against this backdrop, it seems clear to us that individuals, firms, and communities in this state will face intensifying challenges to find ways to maintain economic prosperity while reducing their environmental impacts. Having one without the other will become less and less acceptable.

Many water users in the Basin have reached similar conclusions and found ways to do both. To others, though, old water-use practices created a solid foundation of wealth which is being unreasonably undermined by the demands of "extreme environmentalists" who are seen to have no regrets for the harm they impose on farmers, ranchers, and others whose livelihood depends on irrigation. Those who see the competition for water in these terms probably will continue to cope with the competition by resisting it as resolutely as possible. The remainder of this report, however, addresses those searching for another path.

OPTION 2: DEVELOP NEW SOURCES OF WATER OR WATER-STORAGE INFRASTRUCTURE

Increase withdrawals of groundwater.

Build new dams and water-delivery systems.

Some groups in the Basin and political leaders, are investigating the feasibility of increasing the supplies of water available for use during periods when precipitation is low. Much attention focuses on proposals to expand the storage capacity of Upper Klamath Lake, Clear Lake, and Gerber Reservoir. A number of wells to tap deep groundwater have been drilled in the past year and more are planned. Other proposals include building new dams, and ceasing farm production on lands that once were wetlands and allowing them to store water for use by others.

Almost certainly, however, these proposals will not accommodate all the competing demands or alleviate the scarcity of water in the Basin. Much of the momentum behind the proposals comes from a desire to avoid the difficult adjustments that are likely to emerge with completion of the adjudication of water rights in the Basin, which many anticipate will certify claims of tribal members and for natural-resource protection, claims that would go to the front of the queue, ahead of irrigators' water rights. Increasing the supply of stored water, it is hoped, would allow these newly authenticated rights to be satisfied without reducing the supply of water available to irrigators served by the Klamath Project and others.

Adjudication certainlycreates a sticky social, economic, and political situation. If drilling new wells, expanding existing dams, and building new ones can make the transition smoother, this would be a considerable accomplishment. It does not take more than a casual look at the preceding chapter, though, to realize that such action, alone, will not address the fundamental realities of growing competition for water. If the American public continues to express strong preferences for reversing environmental degradation, then it appears that the environmental impacts of irrigation, urban development, and industrial water uses will have to be rolled back. The problems are unlikely to be washed away simply by pumping water from aquifers faster than nature can recharge them or by collecting more water in the winter and flushing it down the rivers in the summer.

Adding future population and economic growth to the mix will make the economic demands for environmental improvement even stronger. Even if bigger and newer wells and dams enable the Basin to avoid these problems for awhile, water users in the Basin will continue to be confronted with the necessity of finding ways to grow crops, raise livestock, and build cities while imposing a lesser burden on water and related resources than exists today. This is the option we explore in the next section.

OPTION 3: RETAIN THE GENERAL SCALE AND PATTERN OF WATER USES, BUT REDUCE THE ECOLOGICAL HARM

Adopt urban-development practices and technologies that conserve water.

Adopt urban-development practices that reduce impervious surfaces.

Install water-conserving irrigation technologies.

Adopt crops and farming practices that are more ecologically benign than those used today.

There are many ways for farmers, developers, transportation planners, industrial-plant managers, homeowners, and others to reduce their negative impacts on the Basin's water and related resources. Moreover, many of these steps can save money! We briefly summarize the issues and evidence for municipal-industrial water users and then for irrigators.

Municipal-industrial water users

Urban water is artificially cheap whenever municipal utilities and self-supplied water users pay nothing for the water itself, and water rates cover only the cost of extracting the water from the ecosystem, conveying it to where it is wanted, and treating it to make it more usable. In addition, land developers, road builders, and city taxpayers do not bear the full costs of coping with stormwater runoff and the introduction of pollutants into water bodies. As a consequence, there has been a widespread tendency to create development patterns, industrial practices, and household appliances that waste water or degrade its quality.

Things, however, are changing. There is strong national pressure, in both public policies and through private price incentives, to reduce waste and pollution. Once they look at the facts more closely, firms, communities, and households are finding that reducing waste can also save money. Here are some examples:

- Residential, commercial, and public-agency water users account for two-thirds of all non-farm water diverted from the streams in the Pacific Northwest. If simple conservation measures were adopted throughout Washington and Oregon, region-wide water consumption would fall by 14.9 billion gallons each year, or about 1,600 gallons per person, and water customers would have a net savings of $12 million annually on their water bills (calculations by ECONorthwest with data from Seattle Public Utilities, 1998). For a population of 50,000, the reduction in water use would total about 80 million gallons annually.
- Water-conserving technologies are coming. Recently adopted designs, for example, will halve the water used by clothes washers.
- Community-wide actions can save taxpayers money. A study of twelve communities in Delaware compared the fiscal impacts of continuing conventional, "sprawl" development relative to an alternative that emphasized open space, mixed residential-

commercial land uses, and concentrated growth around existing urban centers. It found that they saved almost $50 million in the costs of local roads, water treatment, and sewer treatment. In addition the costs of housing declined more than 8 percent (Burchell et al. 1995).

- Green building practices already being applied by some builders in Oregon can reduce impervious surfaces by at least 50% (ECONorthwest 2000). Important techniques include on-site drainage ponds, rainwater catchments and the use of pervious materials, such as gravel or crushed stone, rather than asphalt or concrete.

Irrigation water users

Irrigators also can save money while they reduce their environmental impacts. The "success story" described on the next page provides one illustration of what farmers believe can be done. Numerous other successes can be found in the Basin and around the West. They demonstrate that technologies and practices exist for application by farmers and ranchers throughout the Basin.

In general, the changes needed to transform agriculture in the Basin fall into two groups: changes in production methods and changes in how farmers sell their products. Each can be considered separately, although their greatest ecological and financial potential materializes when they are pursued in tandem.

Potential changes in production methods. Potential changes in production methods include adoption of these practices:

- Irrigation methods. Carefully controlled spray or drip irrigation systems use far less water than flood-irrigation methods, where the water is allowed to run over the ground.
- Conservation tillage systems. These include no-till, mulch-till, and ridge-till methods for reducing soil erosion.
- Riparian (streamside) buffer zones. These intercept pollutants in runoff before they reach streams, offer shade that helps stream water remain cool, and provide essential components of aquatic habitats, such as streambank-shelter areas. In some cases, the buffers can still produce income-generating crops.
- Integrated pest management (IPM). This approach to pest management seeks to capitalize on naturally occurring pest controls, such as weather, disease agents, predators, and parasites. As naturally occurring pest controls become more effective, farmers can reduce their use of pesticides and herbicides.

An Irrigators' Success Story

As environmental officials in Idaho identified total maximum daily loads (TMDLs) for the mid-Snake River, farming practices were recognized as a contributing factor to high levels of sediment and other pollutants but, because irrigators are considered non-point source polluters they were not required to take action to meet the TMDLs. Nonetheless, irrigators at the Twin Falls and North Side Canal companies took voluntary action, in part because they recognized that, if they meet TMDL goals, they will be subject to less future regulation.

The canal companies created two mechanisms to lower sediment levels. The first employs 60+ sediment-catchment ponds or wetlands to capture sediment that has left fields. The second reduces sediment coming off fields by requiring that the quality of water leaving a property is as good as it was when it entered the property. If irrigators fail to maintain water quality, each company's bylaws now permit the offender to be denied access to water. To date, they have not had to enforce compliance.

The farmers have focused on three tools to reduce sediment levels in return flows: sprinkler irrigation, the use of flocculents, and conservation-tillage practices. Ten years ago, about 99 percent of the farms supplied by the North Side Canal Company used flood irrigation. Today, only 20 percent do. The rest have converted to central pivot sprinkler systems, which, though costly, require less labor, less water, and improve crop yields. They allow farmers to control water delivery more precisely, and control problems from uneven irrigation. Overall, they are they are less expensive to operate than a flood irrigation system, and some operations have seen a payoff within ten years.

The farmers use polyacrylamide as a flocculent. When a small amount is added to irrigation water, it causes particles to cling together. Sediment collects in larger and heavier clumps, so it is less likely to drain off the field with the irrigation water. With assistance from the Natural Resources Conservation Service, farmers have developed tilling methods that also effectively reduce soil loss.

Farmers have benefited financially from these actions and they also recognize their conservation value. Past irrigation and tilling techniques accelerated topsoil erosion and, had they not changed their methods, they would have eliminated their topsoil within 50 years. With the new actions, farmers save cleaning and maintenance costs that previously occurred when erosion clogged drainage systems.

Although the effort has drawn some criticisms for not doing more, the farmers, canal companies, and the Idaho Dept. of Environmental Quality consider the program a financial and conservation success. Last year, the North Side Canal Company met the TMDL goal for 2004.

ECONorthwest, from interviews with officials from the Twin Fall Canal Company and the Idaho Dept. of Environmental Quality

Widespread adoption of these changes in farming methods can reduce agricultural impacts on the environment substantially. Water-conserving irrigation technologies can reduce agricultural water withdrawals by almost 50 percent, as shown by the data in Table 10. Derived from a 1990 study by the U.S. Geological Survey of water use in Oregon (Broad and Collins 1996), the data show the application efficiencies of different irrigation technologies in Eastern Oregon. With flood irrigation, where water is allowed to flow over a field, 45 percent of the water applied is consumed by the crop. In other words, more than half the water withdrawn and applied to the field is not used by the crop, but seeps into the groundwater, evaporates, or runs off the field. In contrast, center-pivot and drip irrigation have application efficiencies nearly twice as high: 82 and 85 percent, respectively.

Table 10: Application Efficiency of Different Irrigation Technologies, Eastern Oregon

	Percent of Water Applied that Is Consumed by Crop
Flood	45 %
Drip	85 %
Center pivot	82 %
Big gun	67 %
Other sprinkler	65 %

Source: Broad and Collins (1996)

Broad and Collins also found that flooding accounts for more than 90 percent of all irrigation in the Sprague River, Williamson River, and Upper Klamath Lake sub-basins, and for 43 percent in the Lost River sub-basin. If, on average, conversion to sprinkler technologies would raise the application efficiency from 45 to 75 percent, then at the current application rates, 3.7–4.0 feet, such conversions would conserve about 1.1 acre-foot per acre. Table 11 shows the potential water savings if all flood irrigation were converted to sprinklers with an efficiency of 75 percent. For all four sub-basins, if farmers and ranchers converted to sprinklers and did not change the total acreage irrigated, they would be able to satisfy the needs of their crops and reduce their withdrawals of water by 175,000 acre-feet per year.

Additional savings could occur on the 100,000 acres in California irrigated by the Klamath Project. If they have a water-conservation potential similar to the 130,000 acres in the Lost River sub-Basin, then adoption of sprinkler irrigation could save an additional 48,000 acre-feet per year. The total savings would be 223,000 acre-feet.

Table 11: Potential Water Savings from Sprinkler Irrigation in Klamath County

	1990 Withdrawals (1,000 acre-feet)	Land w/ Flood Irrigation (1,000 acres)	Potential Water Savings[a]	
			1,000 acre-feet	% of 1990 Withdrawals
Williamson R.	93.0	25	28	30
Sprague R.	87.4	23	25	28
U. Klamath Lake	201.6	55	60	30
Lost R.	593.7	56	62	10
Total	975.7	159	175	18

[a] See text for description of underlying assumptions.

Source: ECONorthwest, with data from Broad and Collins (1996) p. 128.

These estimates are not intended to say that such conversions are feasible for every farmer or compatible with the operational designs of irrigation districts, but to provide a rough order of magnitude for the water-conservation potential in the Basin. The savings would be smaller if not all lands were converted to sprinklers or if irrigators adopted sprinkler technologies with an application efficiency less than 75 percent. Conversely, even greater savings could be achieved if irrigators adopted technologies with the higher efficiencies.

Of course, converting to sprinkler systems would cost money and it is tempting to say that, since farmers have not already converted to sprinklers, the costs must be prohibitive. Tempting, but not necessarily correct.. The costs vary by technology. A recent (8/24/01) assessment by the editors of the Capital Press, which calls itself an "Agricultural Weekly," had these observations from around the region:

- "At $1,000 to $1,100 per acre, the installation costs [of a heavy-duty drip tape] costs slightly less than a solid-set sprinkler system, but uses less water and power to keep a crop healthy."

- "Installation costs of about $1,300 per acre [for permanent drip irrigation tubes 9 inches deep] run high against furrow irrigation at around $100, center pivots and wheel lines at around $700 and solid-set sprinklers at about $1,200 per acre. But the buried tape ought to last 10 to 15 years and the system can cut water use by half from other methods, while it reduces field trips and improves fertilizer and chemical delivery."

- "A water-sensing probe … helps strawberry irrigation managers cut their water use by 30 percent to 40 percent, simply by informing them how much water is actually in the soil. A $1,500

> investment in this technology could buy enough equipment to monitor water use on 40 acres."

These observations highlight the fact that water-saving technologies have both costs and savings. As researchers investigate the financial impacts of adopting earth-friendly measures, they often find that farmers (and firms, households, and public agencies) have not taken these measures even though they would save money by doing so. Furthermore, there may be opportunities for reducing the cost burden borne by individual farmers, through subsidized loans, grants from federal agencies, or cost-sharing agreements with groups promoting sustainable practices.

A similar story applies to conservation-tillage methods, which entail reducing soil disturbance by inserting seeds directly into the ground, rotating crops with an eye on minimizing soil loss, and leaving more organic material on fields when crops are harvested. Adopting these methods almost certainly would save some farmers money. Not incidentally, they also would conserve soil, soil productivity, and water. A recent analysis of soil-conservation methods indicates that most farmers in the Pacific Northwest would at least break even by adopting them, because, despite initial investment costs, these would be offset by declines of 5–20 percent in long-run costs (Sable and Doppelt 2000). Such savings are not trivial, especially when the census data in the preceding chapter show farmers in 1997, on average, earned about 4 percent on the total value of land, building, equipment and machinery in 1997, and one-third of the farms in Klamath County lost money. Net earnings have fallen sharply since then—statewide, they fell 35 percent in 1999, alone.

Despite the savings potential, few farmers have adopted conservation methods. Farmers in the Pacific-Coast states are using no-till practices on only 1 percent of the cropland, whereas the national average is almost 15 percent (research cited in Sable and Doppelt, 2000).

The low rate of conservation-oriented farming has both environmental and economic implications. The recent *Oregon State of the Environment Report 2000* (Risser and SOER Science Panel 2000), for example, reports that sedimentation of streams is a serious environmental problem throughout the state. Moreover, although soil is created at a rate of 1—5 tons per acre per year, per-acre losses in the state often exceed the replacement rate, running from 2.5 to as high as 10.6 tons per acre per year. The nutrients in the soil that leaves fields generally are more concentrated than in the soil left behind so that, following erosion, farmers incur additional costs to augment the remaining soil with soil supplements and fertilizers. Soil erosion also can be accompanied by loss of water. One national study found that the loss of each ton of soil results in additional costs for

Soil-Conservation Advantages

In Oregon, 1–5 tons of soil are created per acre per year, but 2.5–10.6 tons of soil may be lost per acre from erosion on agricultural lands. The soil that leaves fields generally has higher nutrient concentrations and greater ability to hold water.

The loss of each ton of soil costs farmers $3 to replace the lost nutrients and $2 to replace the lost moisture. Off-farm costs that materialize when sediment clogs ditches, fills-in stream channels, and causes other damage exceed $3 per ton.

Putting these estimates together indicates that erosion costs about $20–80 per acre per year. Much larger costs may occur from adverse impacts on at-risk species and other environmental damage.

In contrast, the 1997 census found that the average net cash return to farms in Klamath County was $34 per acre, and plummeting prices for most commodities have since driven earnings lower.

farmers of $3 to replace the lost nutrients and $2 to replace the lost moisture (Pimentel et al. 1995). In addition, the off-farm costs that materialize when sediment clogs ditches, fills-in stream channels, and causes other damage exceed $3 per ton (Niemi, Whitelaw, Gall and Fifield 1999; Ribaudo 1989). And these estimates do not include the potentially much larger costs from adverse impacts on at-risk species and other environmental damage.

Putting these estimates together provides a general context for weighing the economic significance of soil erosion from farms in the Basin that do not practice conservation methods. At the highest level of erosion reported in the *Oregon State of the Environment Report 2000,* erosion costs farmers and the overall economy about $80 per acre per year. At the lowest level, the costs are $20 per acre per year. Again, these estimates do not include many costs, such as impacts on at-risk species or reductions in the populations of salmon available for tribal, commercial, and recreational fishing. Nonetheless, they are significant, as can be seen by comparing them with the money farmers earn from their lands. The 1997 census found that the average net cash return to farms with sales of at least $10,000 in Klamath County was $34 per acre, and plummeting prices for most commodities have since driven earnings lower.

Relative to common tillage systems, conservation-tillage methods can cut erosion-related costs markedly, by reducing erosion 50–90 percent. In addition, they also reduce other production costs, because they involve fewer tractor trips over a field for planting and cultivation, and result in soils that are more productive and require less water. One recent study found that, when no-till methods were used to grow wheat in the Pacific Northwest, the total cost dropped 10 percent (research cited in Sable and Doppelt, 2000).

There appears to be nothing unique about the Basin that necessarily prevents the cost-savings found elsewhere from being realized here. Indeed, some farmers in the Basin have recognized the economic importance of conservation and adopted a large suite of conservation-oriented changes. This is not to say, however, that the conservation farming practices identified above will suit the interests of every farmer in the Basin. Increasingly, though, as evidence of conservation successes mounts, farmers in the Basin may experience increased economic pressure to adopt conservation practices.

Potential changes in marketing. Conservation efforts also can be pursued through changes in how agricultural products are marketed to consumers. Increasingly, as American farmers compete more intensely with each other and with farmers in other countries, those who produce commodities find themselves squeezed between higher costs of production and lower prices for their products. Matters are made worse for local farmers as the structure of the industry changes so that farmers have fewer opportunities to earn income. This occurs, for example, when a food processor provides the labor and machinery to plant and harvest crops, thereby depriving the farmer of the income he or she otherwise would have earned from these activities.

Many farmers resist these trends by assuming more responsibility for marketing directly to consumers. Many direct-marketing techniques—such as selling through farmers' markets or creating a brand and trying to establish sufficient brand recognition to support higher prices—have been around for a long time.

Farmers that take a conservation-oriented approach to cutting their production costs, though, have another option for distinguishing products from the commodities already available. If their production methods meet specific standards, ecologically, their products can be certified as organic or sustainably produced. At least four groups in the Pacific Northwest are available to provide third-party certification of farming practices and products in the Basin:

- Salmon-Safe, which certifies land-use and water-use practices.
- Oregon Tilth, which certifies organic growers.
- The Food Alliance, which certifies sustainable agriculture.
- Scientific Certification System, which, through its NutriClean programs certifies that foodstuffs are free of pesticides.

Sales of certified products are growing rapidly and many in the food industry expect sales will continue to grow at least 20 percent annually (Sable and Doppelt 2000). More important, evidence compiled by Sable and Doppelt indicates that products certified as

Organic Price Premiums

"Supermarket sales of both organic and conventional frozen french fries increased during 1994-96, but organic sales grew at a much faster rate. … During 1991-96, the average price premium [for organic frozen vegetables] ranged from a low of 96 percent for sweet corn to a high of 231 percent for green peas."

"At least 52 percent of consumers want to buy earth-sustaining food products."

"For three [of the four years studied] the organic system produced the highest net return per acre, and the highest average return per acre over [the entire] four years."

"On average, organic wheat sold for about $2.75/bushel over and above the price of conventional wheat in 1997 and for about $2.40-$2.50/bushel more than the price of conventional wheat in 1998."

Quotes from research cited in Sable and Doppelt (2000).

environmentally friendly command prices 20–100 percent higher than those produced with conventional agricultural methods.

In an analysis of a hypothetical, 100-acre farm typical of the Pacific Northwest, Sable and Doppelt concluded that, even if adoption of the conservation-oriented methods described above increased production costs, these probably would be outweighed by higher prices received for certified crops. Such an analysis does not, of course, mean that every farm in the Basin necessarily would become more profitable if it adopted such farming methods and pursued certification. It does, however, indicate that these methods are potentially feasible and warrant further investigation, by individual farmers, groups of farmers, and society as a whole.

Lower costs and higher prices are not the only financial advantages of a conservation-oriented approach to farming. Some growers have been able to realize greater stability in their markets after being certified by an appropriate third party. Certification gives producers access to markets that otherwise would be closed. This, together with a rapidly growing market share for certified products, allows some buyers to extend stable pricing to their suppliers. Sable and Doppelt, for example, offer this quote from Theresa Marquez, director of sales and marketing for Organic Valley:

> "We have more than a price premium, we provide stable pricing. That's unheard of in agriculture. Conventional farmers are getting somewhere between $11 and $13 per hundred weight. Organic Valley is getting $18 to $20 per hundred weight, easily a 50% premium, and we don't change it, which allows farmers to plan. In our system the farmers also get a larger percentage of the bottom line."

Farmers, of course, are not the only ones who read studies about the financial feasibility of conservation-oriented farming methods. Major retailers seeing this information and receiving pressure from consumers demanding earth-friendly products, may seek a market niche by requiring their farm producers to meet strict environmental standards. Something similar has already happened with lumber and paper products, where Home Depot, Kinko's Copies, and other retailers now race each other to reassure consumers that they sell only earth-friendly products. Some speculate that a similar trend with foodstuffs may be in the offing.

In sum, conservation-oriented farming practices seem to offer many, if not most, farmers in the Basin a potentially attractive option for improving their financial outlook, reducing their adverse impacts on the Basin's surface waters, and undercutting the competitive pressures they feel from environmental advocates. Our aim here is not to suggest farmers in the Basin take any specific path. Instead, we highlight some of the salient trends that appear to be developing and suggest that they will alter the economic and political setting within which the competition for water resources will take place for the foreseeable future. We believe the data in the preceding chapter support the conclusion that the farm and ranch demand for water is not growing as rapidly as the demands related to ecological services. Absent a turnaround in agricultural markets or a reversal in society's preferences for environmental quality conservation-oriented production and marketing should become increasingly attractive as an option for at least some of the Basin's farmers.

OPTION 4: CHANGE THE GENERAL SCALE AND PATTERN OF OUT-OF-STREAM USES

- Retire land from irrigated agriculture.
- Manage the density of urban development to minimize water use and pollution.
- Accent the consumer amenities derived from the Basin's water resources, but avoid congestion.

This option entails major changes in the Basin's approaches to agriculture, urbanization, and economic development. Water would be reallocated, away from irrigation and toward the production of ecological services, such as the restoration of habitat for species at risk of extinction and the production of amenities important for recreation and spiritual renewal. Urban development patterns would be adjusted to reduce the amount of sprawl and runoff-related pollution.

Retire irrigated land

Significant retirement of irrigated land could occur through the cessation of irrigation on entire farms or fields, or by establishing buffer strips along entire watercourses. Doing so would, in concept, return about 3.7—4.0 acre-feet of water to the ecosystem per acre of land retired, and there would be a comparable reduction in the amount of irrigation-related pollution introduced into streams and lakes.

In practice, though, the impact might be quire different. Curtailing irrigation in one place might be accompanied by increased irrigation in another. A farmer, for example, might curtail irrigation of one field, but on another try to grow a crop that requires more water, on a per-acre basis. Or, as one farmer decreases irrigation, others might increase it (Jaeger and Mikesell 2000).

The impacts on water quality might be even harder to predict. Ceasing irrigation on a field, for example, might decrease the amount of pollutants being carried into groundwater under the field, but it also would diminish the amount of water able to dilute existing pollution.

The net effect on groundwater, and on surface water containing groundwater seepage, will be difficult to predict, from place to place (Connor and Perry 1999).

Some fear that the elimination of irrigation would stimulate greater residential, and even commercial and industrial, development on what is now farmland. This threat is larger, the nearer the land is to an urban center. Regardless of location, many would dislike the conversion on aesthetic and other grounds, but from a water perspective, conversion to residential land uses probably would result in a net increase in streamflows. Irrigators currently annually apply about 3.7–4.0 acre-feet of water per acre. This amount of water is comparable to the amount of residential use associated with 15 people, at usage patterns typical of the Klamath Falls area, and comparable to the use associated with about 25 people, at usage patterns typical of the Sprague and Williamson sub-basins. If, however, one adds in industrial and commercial uses on a per capita basis, retiring one acre of irrigation would provide enough water for about 3 people (Broad and Collins 1996).

Establishment of streamside buffer strips can be a cost-effective way for farms and other land uses to reduce the pollution returning to streams from fields and to create more natural streamside habitat. Studies have shown that converting land currently being farmed along streams to the production of a diverse mix of trees, shrubs, and grass can reduce the concentration of sediment and agricultural chemicals in streams more cheaply than alternative approaches, such as using special farming methods on the most erosive parts of fields (Qiu and Prato 1998). The establishment of streamside buffers need not mean the elimination of income from these lands: farmers may be able to sell wood fiber from plant hybrid poplars, for example, or receive federal payments by entering the land into the Conservation Reserve Enhancement Program.

As with other irrigation-retirement proposals, however, the overall outcome can be complex. Increases in stream quality resulting from buffer strips, for example, may relax restrictions that keep farmers from using more water-intensive farming methods on neighboring fields. Further investigation of this option will be required before its potential impacts are fully understood.

Minimize urban water use and pollution

There are two general approaches for reducing urban water use. One entails voluntary and mandatory efforts to persuade water users to adopt water-saving appliances and behaviors. The other involves using higher prices to provide water users economic incentives to conserve water in whatever ways they may choose to do so.

For the most part, water utilities in the U.S. have relied primarily on the first of these approaches. Not every community has pursued conservation programs, however, and a 1998 survey of water utilities in Oregon, found that the City of Klamath Falls, the largest municipal water utility in the Basin, was one of few communities in Oregon that had budgeted no money to promote conservation (Oregon Environmental Council 1998).

Whatever their involvement with conservation programs, utilities increasingly are looking toward prices to bring about conservation, both because utilities are seeing that price can be a powerful tool for rationing a scarce resource, and because prices are increasing to cover the costs of meeting higher water-quality standards. The City of Klamath Falls gives mixed pricing signals. The findings from the 1998 survey indicate that its price level generally encourages conservation, relative to other cities. The city charged consumers inside the city $1.34 per hundred cubic feet (ccf) for the first 14 ccf, and $0.75 for everything over that threshold. Few cities in the state had rates this high. Medford, for example, charged $0.28/ccf in summer months, and Bend charged $0.61/ccf, although each also had a fixed monthly fee.

The fundamental price structure, however, tends to undermine the signals given by the price levels. The drop in prices for large water users is widely considered by water planners to be a disincentive to conservation for those large users who often have the greatest conservation potential.

Future efforts to reduce municipal-industrial water use in the Basin could include both the implementation of water-conservation programs and, probably more important, the adoption of stricter pricing. Charging higher prices to those who use more water seems an important candidate to be considered. Recent adoption by The Dalles of a pricing structure where those who use more pay a higher price, for example, resulted in a 20 percent reduction in overall water use. Ashland is the closest community to Klamath Falls that charges higher prices for higher use. Rates in Ashland in 1998 were $1.17/ccf for the first 3 ccf, $1.53/ccf for the next 7 ccf, and $1.94/ccf for everything over 10 ccf. In addition, the city charged a monthly fee of $8.30 (Oregon Environmental Council 1998).

Residents of the Basin also should be aware that future economic growth can have a big impact on water use. Table 12 shows the industrial-commercial water usage, per employee for different industries. The data come from two sources, a national survey that yielded rough estimates, and a detailed investigation of water usage in Eugene. Not surprisingly, some types of manufacturing typically use more water than other industries. A plant in the pulp-and-paper industry, for example, uses more than 10 times as much water, per employee, as establishments in retail, services, and similar sectors.

Table 12: Nonresidential Water Use, by Industry (gallons per employee day)

Industry	National Study Annual	Eugene Study Annual	Eugene Study Summer	Eugene Study Winter
Construction	31	31.65	39.98	25.32
Manufacturing	164			
Food and Kindred Products	469	945.5	1357.1	533.9
Lumber and Wood Products	49	217.1	252.9	181.34
Paper and Allied Products	2614			
Other Durable	40	90.04	99.04	81.03
Other Nondurable	256	249.59	274.55	224.63
Transportation and Public Utilities	50	84.49	101.39	67.59
Wholesale Trade	53	47.42	56.91	37.94
Retail Trade	93	103.75	124.5	83
Finance, Insurance, and Real Estate	192	86.41	103.7	69.13
Services	137	130.63	156.75	104.5
Public Administration	106	348.3	510.9	185.6

Source: Opitz, Dziegielewski, and Steinbeck (1995).

Some manufacturers in the electronics industry also use large amounts of water. The new Hyundai plant that manufactures silicon chips in Eugene, for example, originally estimated that it would use about 2,000 gallons per employee-day, but, in practice, scaled this back to about half that level, in part because the water utility imposed a pricing structure that charges higher prices for greater water use.

Accent water-related consumer amenities, but avoid congestion

As we explain in the preceding chapter, there are strong trends and forces supporting the conclusion that the Basin should experience considerable economic growth, as skilled workers, entrepreneurs, and retirees are attracted by the Basin's quality of life and, particularly, by its natural-resource-related, consumer amenities. Some of the Basin's water and related resources, such as its waterfowl and some of the fishing opportunities, have world-class significance. Others are important regionally and locally. Unless these resources become degraded to the point that they lose their attractiveness the region should anticipate considerable future growth.

Taking advantage of these resources will entail reinforcing the national—even global—trends and forces by enhancing the amenities, and especially those linked to water. This conclusion is reinforced by numerous studies, often conducted for communities desperately trying to attract skilled workers, entrepreneurs, and retirees. Consider, for example, these recommendations to civic leaders of a major East Coast city:

> “Knowledge workers prefer places with a diverse range of outdoor recreational activities (e.g., rowing, sailing, cycling, rock climbing) and associated lifestyle amenities. Access to water and water-based recreation is of particular importance to these workers. Knowledge workers prefer regions where amenities and activities are easy to get to and available on a ‘just-in-time’ basis. Due to the long hours, fast pace, and tight deadlines associated with work in high technology industries, knowledge workers require amenities that blend seamlessly with work and can be accessed on demand. They favor cities and regions that offer a wide range on experiences, and are somewhat less concerned about ‘big ticket’ amenities such as ‘high’ arts and culture or professional sports. Knowledge workers also express a strong preference for progressive regions that are youth-oriented and supportive of demographic diversity.”
>
> Florida (2000)

Numerous cities and counties throughout the West have made similar assessments of economic trends and adopted economic-development plans to capitalize on them. If the residents of the Basin decided to pursue a comparable strategy, top priorities would include protecting and, where appropriate enhancing, the quality of the Basin’s water resources, as well as protecting and, where appropriate expanding, access to them. With bike and canoe trails that highlight personal interaction with water resources, these resources might become equivalent to infrastructure supporting manufacturing and service establishments, such as the complex being developed near Oregon Institute of Technology. An expanded network of interpretive centers related to the Basin’s waterfowl, Bald Eagles, and other resources might strengthen the area’s profile as a place for people to visit, live, and invest, with the expectation that the natural-resource amenities will only get better.

There should be no doubt that, if the U.S. economy continues to expand, raise household incomes, and increase the mobility of both firms and households, growing numbers of people will be searching-out places, such as the Basin, as sites for homes and businesses. Once amenity-driven growth materializes, though, Basin residents could quickly confront rapidly escalating congestion, one of the uglier sides of amenity-based growth. Congestion generally represents a reduction in quality of life, especially for old-timers. Nonetheless, few communities facing amenity-based growth have been successful in taming congestion before it got out of control. Those now living here may prove the Basin is one of the exceptions but, if not, then a major shift of water resources away from current uses to the production of ecological services will be accompanied by a similarly major increase in congestion associated with the Basin's water and other resources.

REFLECTIONS

The discussion in this chapter has one central theme: those who feel threatened by the rising ecological demands for water have choices. Some involve doing things in the future as they have been done in the past, while others entail major changes in behavior and attitude. No one choice is free of risk. Rather, each embodies its own mix of risks and rewards.

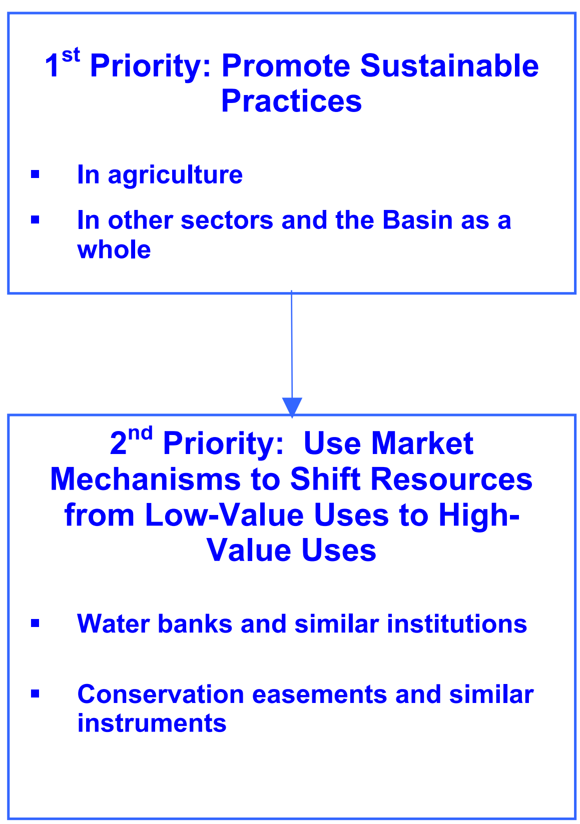
There is no road map for choosing which way is best. We are reminded, though, of advice offered by Thomas Michael Power, chair of the Economics Department at the University of Montana, when he warns of making decisions as if one were trying to drive while looking not through the windshield but in the rear-view mirror. Doing so offers the comfort of seeing familiar terrain and can work pretty well when the road ahead is a straight-line extension of what lies behind. But, when the road ahead veers sharply from what lies behind, it is a prescription for disaster.

In this chapter and the one preceding it we have summarized what we believe to be true about the economic road ahead for the Upper Klamath Basin and how it relates to what lies behind. We hope this information proves helpful as farmers, tribal members, city leaders, environmental advocates, and others weigh the potential risks and rewards of driving straight ahead versus negotiating some pretty sharp turns.

WIN-WIN OPPORTUNITIES

The evidence presented in the previous chapters strongly indicates that the competition for the Basin's water resources will intensify, primarily from rapid growth in demands to shift water away from current irrigation practices and toward the production of ecological services. Nobody knows precisely how the shift will evolve, but most will agree that some routes are preferable to others. Those shown in Figure 5 represent the best alternatives: opportunities where both those interests that will see more water going to satisfy their demands and those that will see less end up better off, economically, than they would otherwise.

Figure 5: Win-Win Opportunities for Coping with the Competition



To understand the win-win opportunities, consider first the alternatives. If those being pressured to relinquish water dig in their heels, they will (a) incur costs (money, time, political capital, etc.) to pursue their case, but (b) eventually, many, if not most, may find they face overpowering economic forces. This seems an unavoidable outcome if the net earnings from farming remain weak as the demands for ecological services grow rapidly. At the same time, those seeking the water for ecological services will (a) incur costs (money, time, political capital, etc.) to pursue their case, and (b) fail to satisfy their demands while the battle ensues. Furthermore, both groups share a common risk: that land currently in farm-ranch use will be developed for residential, commercial, or industrial use, thereby destroying the agricultural character of existing communities and reducing even further the Basin's ecological productivity.

Our objective in this chapter is to demonstrate that there are opportunities for the different parties to all come out ahead. Each of the opportunities is complex and our objective is not to investigate all the details. Instead, we aim to provide enough information so that those with an economic, cultural, spiritual, or other interest in the Basin can see enough to understand the possibilities.

1ST PRIORITY: PROMOTE SUSTAINABLE PRACTICES

Aggressively investigate the options for certified, earth-friendly agriculture.

Promote individual support among farmers for earth-friendly agriculture.

Aggressively investigate and discuss the options for uniting sustainable agricultural practices with sustainable practices in other sectors.

We recommend that the highest priority be given to promoting sustainable practices—both in agriculture and other sectors—throughout the Basin. We do so for these reasons:

1. Industrial societies cannot forever consume virgin resources and emit toxic materials into the biosphere without incurring serious, negative, feedback consequences. A growing body of evidence indicates such consequences already are occurring, and, barring a reversal of current trends, these will become more severe in the foreseeable future.

2. The momentum favoring sustainability is building. A rapidly growing body of institutions is investigating what it will mean and what it will take to move toward sustainable practices, with Oregon taking the lead when the governor directed state agencies to begin implementing sustainable practices. All these efforts mean (a) there is much that residents of the Basin can learn from the experience of others, and (b) the Basin has much to gain by getting ahead of the curve rather than being left behind.

3. The Basin already contains leaders in the sustainability movement, among them Collins Pine, a wood products company. Their presence raises the possibility that many sectors in the Basin can band together and create a Basin-oriented brand name recognized by consumers. A broad shift toward sustainable practices would spread out the costs of research, education, and marketing, lowering the burden on each participant.

4. The adoption of sustainable practices promises to raise net earnings for at least some farmers in the Basin. (In the preceding chapter we summarize the evidence underlying this conclusion.) Without such an increase in earnings, a continuation of recent market conditions and structural trends in the agricultural industry leave many fearing that many farmers will go bankrupt.

We recommend sustainable practices be pursued along three fronts. First, assemble the relevant facts and investigate the options by learning more about the markets for certified products and the mechanics of sustainable agricultural practices. Second, define corollary actions, such as changes in regulatory restrictions, that would facilitate a shift toward sustainable practices. Third, identify potential sources of financial capital and technical assistance.

It also will be important to communicate the investigative findings clearly, widely, and repeatedly. Farmers, like other entrepreneurs, are cautious about implementing marked changes in their operations. To overcome this caution, any promotion of sustainable practices must effectively communicate the advantages of sustainable practices.

Farmers have essential roles to play in each of these activities, but there also is much that environmental groups and others can contribute. Collaborative efforts focused on finding ways to increase farmers' incomes *and* improve the environmental impacts of farming may be something that farmers, environmental groups, the tribes, and other groups can agree on. If so, pursuing and disseminating information about sustainable practices may be an exercise that can reduce the distrust between the two groups, and increase the likelihood that they can pursue other common goals as well.

One potential advantage of pursuing sustainable practices is that, if they prove effective, they may create opportunities to shift water from irrigation to the production of ecological services without fighting a battle over who owns what rights over the water. Such battles have a winner-take-all character to them and, hence, become bitter, drawn-out, and expensive. With the adoption of sustainable practices, though, a farmer could leave water in the stream and still see earnings increase. Thus, with the prospect of win-win outcomes, they and other interest groups may be willing to sidestep battles over the ownership of water.

2ND PRIORITY: USE MARKET MECHANISMS TO SHIFT RESOURCES FROM LOW-VALUE USES TO HIGH-VALUE USES

Aggressively investigate the options for water banking and other innovations.

Promote the use of conservation easements and similar instruments.

Our second priority focuses on opportunities for changing the ownership of water and other resources in a manner that satisfies all parties, or at least most of them. In some cases, such as commitments by farmers to sell the American Land conservancy 32,000 acres, these opportunities might entail the full transfer of ownership. Others, though, would leave the basic ownership untouched, and transfer a limited bundle of ownership rights.

Using market mechanisms is advantageous because they allow a seller and a buyer to negotiate until they've reached an agreement satisfactory to both. Such outcomes are often considered preferable to those that come through some form of coercion, such as a judge's ruling on litigation.

Water banks and similar institutions

To pursue this priority, we recommend farmers and others aggressively investigate options, such as water banking, that would involve the transfer of some ownership rights and focus on shifting water to the production of ecological services only when the demand is greatest. Under such a banking scheme, an irrigator might agree not to irrigate in dry years, when stress on aquatic species is greatest, in exchange for guaranteed payments according to an agreed-upon schedule. Such agreements would allow farmers to irrigate fully during wet years, and ensure that they have an income during dry ones.

If a water bank were in place at the beginning of a year, some farmers, after looking at the outlook for crop prices and the probability that the summer would prove to be a dry one, may opt to forgo planting rather than take the risk that water would be turned off. Similarly, federal wildlife officials might assess the situation and decide to initiate negotiations with willing buyers to encourage additional farmers to forgo planting and release their water back to the stream.

Admittedly, all this is far easier said than done. It can be done, however, and it holds great potential. In particular, developing new institutions, such as water banks, would give farmers, wildlife managers, and others more options, thus enabling each party a wider set of choices for reducing risk. Currently, farmers face choices about what seed to plant, equipment to buy, when to plant, and many other aspects of crop production. Even so, however, the risks are great, as evidenced by the fact that, for more than one-third of the farms in Klamath County with sales of at least $10,000 in 1997, the revenues from sales failed to cover the costs of production. With falling commodity prices since then, the risks have gotten worse.

Giving farmers an option to receive income by returning water to the stream would enable some of them, at least, to reduce the risk. Similar logic applies to wildlife managers and others.

Conservation easements and similar institutions

We also recommend that farmers, environmental groups, the tribes, federal agencies, and other interested parties aggressively investigate conservation easements and similar instruments involving long-run (perhaps permanent) transfer of some ownership rights. These instruments typically entail a landowner agreeing to restrictions on how she or he manages land or water in return for some negotiated compensation. The owner of property adjacent to a stream, for example, might agree not to farm the streamside area in exchange for a monetary payment, and the agreement would become part of the land deed. Or, alternatively, the agreement might require the landowner to do specific things in the streamside area for the next several decades, and then the agreement would expire.

These long-run instruments, though widely used elsewhere, have not received much use in the Basin. The 1997 agricultural census of Klamath County, for example, found just 5,179 acres, on 21 farms, enrolled in USDA's Conservation Reserve Program (CRP). The CRP pays landowners annual payments in exchange for limiting farming activity on the land for at least a decade. This enrollment constituted 0.7 percent of the total land in farms in the county. In contrast, the statewide enrollment was four times higher, 2.8 percent of total land in farms. Enrollment in some Eastern Oregon counties was even higher—more than 7 percent in Umatilla County, for example.

The lower enrollment in the Basin is somewhat baffling, insofar as, in most parts of the country, poor financial performance has induced farmers to increase their desire to enroll in the CRP and receive guaranteed income. Yet, enrollment in Klamath County is low, even though more than one-third of farms with sales of at least $10,000 had net losses in 1997, whereas, only 25 and 10 percent of farms had net losses for the state as a whole and Umatilla County, respectively.

Why the low participation rate? One hypothesis is that farmers in the Basin had stronger philosophical objections to the principles and practices of the CRP, and to conservation in general. Another is that the Basin lags behind the rest of the state in the dissemination of information about CRP, conservation easements, and similar instruments. There also may have been fewer groups working in the Basin to promote their use. If farmers in the Basins are, in fact, amenable to conservation, then there should be much to gain by doing more to make farmers aware of the opportunities to earn income by removing land from dedicated farm use. The establishment of the Klamath Basin Ecosystem Foundation (KBEF), which includes both agricultural and environmental interests and hopes to begin exercising conservation easements throughout the Basin, may help stimulate both educational activities and actual transactions.

REFLECTIONS

We have no false illusions about the prospects for peace over water in the Basin. Agricultural, environmental, tribal, and other interests will continue to battle over the Basin's water and related resources. Indeed, that's one of our central messages: competition will grow.

Battling to the death, however, is not the only way to cope with competition. Sometimes collective action makes more sense, both individually and collectively, because it can yield win-win outcomes. similar outcomes can emerge by opening the door to transactions among competitors.

Meaningful pursuit of the recommendations we offer in this chapter will require changes in behavior, often heart-rending changes, for everyone involved. We recognize that. We also predict, though, that change is coming, regardless, as the competition escalates. We believe the evidence strongly supports the conclusion that maintaining the status quo will not be an option for many, if not most, of those who currently use the Basin's water resources most intensely.

We may be wrong, of course, and farmers may be able to hunker down and outlast, outfox, or outmuscle all those who threaten to rein in the access to water they have long enjoyed. But what if we are correct? If we are, or even if there is a significant probability that we are, then it seems the prudent course is to pursue our recommendations.

EPILOGUE

We developed these recommendations in a draft report, completed in August, 2000, and this final report differs from it in minor ways. The essence of our description of the competition for water, assessment of strategic options, and recommendations of win-win alternatives remains unchanged.

Many dramatic events have occurred since the draft was prepared, however, raising questions about the extent to which the recommendations and the analysis underlying them remain valid. Most notably the onset of drought dried up water supplies, and federal courts and agencies prevented the use of federal facilities to provide water to some farmers in the Basin. We could not have predicted the drought, but the federal actions seem entirely consistent with our analysis, even predictable. Equally important, how the rest of the region responded to the drought reaffirms the importance and feasibility of our recommendations.

In support of this conclusion, we briefly offer this evidence:

- Although many supporters of farmers lay responsibility for the crisis at the feet of extremist environmentalists and the Endangered Species Act, a more powerful, fundamental explanation comes from the economic analysis presented in Chapter 1. The decisions by the courts and actions by federal agencies were triggered by organizations representing tribal members and commercial fishermen, among others, who have long been competing with farmers for water but turned to the courts after finding no other mechanisms for having their demands recognized.
- The crisis erupted and caught so many by surprise in no small part because many farmers and their supporters had failed to see the legitimacy of the competing demands. Reporting by the news media, plus discourse in various forums (including a policy symposium at Arcata, California) have revealed that many in the Upper Basin did not accept responsibility for the economic impacts that their use of water imposed on others. Many did not even recognize the existence of these impacts.
- There were essentially no market mechanisms in place for coping with the drought and the interrupted delivery of water in the Klamath Project.
- Had they been in place, market mechanisms such as we recommend almost certainly would have responded to the drought and the demands of competing demands in a far more efficient and less dramatic way than has unfolded.
- Experience elsewhere in the Pacific Northwest during 2001 demonstrates the feasibility of the options we recommended more than a year ago. A growing number of farmers and other water users in the region found that adopting sustainable, water-use practices yields increased profits. Electric utilities in the Columbia

River Basin established extensive, fast-acting, and effective market mechanisms to induce irrigators to leave water in streams. Governmental programs provided incentives for landowners to reduce adverse environmental impacts on streams. Private organizations negotiated conservation easements and other instruments that brought income to farmers in return for enhanced environmental protection. Collaborative processes have found ways to improve streamflows with little acrimony in the Walla Walla and other basins.

- Many farmers in the Basin have acknowledged the economic pressures for reducing irrigation demands for water and revealed their willingness to initiate the necessary changes. Numerous news reports have described the financial difficulties farmers would have faced, even if they had had full access to water. A growing number of farmers have agreed to participate in buy-out plans.

Given this evidence, we suggest that our analysis of competing demands, in Chapter 1, offers important insight into the forces pressing for change in how the Basin's water is used, and for predicting how the economy will respond to future allocations of water. The behavior during this year by different groups in the Basin represents the full array of strategic options we describe in Chapter 2. Many farm supporters have hunkered down in full-combat mode, some have pursued new sources of water, others have begun seeking to implement marginal changes in water-use practices to alleviate the pressure, while still others have initiated more sweeping changes. The evidence from elsewhere in the region, however, indicates that the most long-lasting response to the competition for water lies in the two win-win recommendations we describe in this chapter.

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APPENDIX: PERSPECTIVES ON THE BASIN'S ECONOMY

The Basin's economy has endured tough times during the past two decades and many attribute the problems primarily to decisions by the federal government that withdrew natural resources—especially timber—from established industries. We see things differently. These decisions certainly had negative impacts on some workers, families, businesses, and communities in the Basin, but these impacts were not as large as the impacts stemming from other, fundamental shifts in the economy. Moreover, the environmental-protection decisions also have had significant, positive impacts that offset the negative impacts on the Basin's economy, although the benefits do not necessarily accrue to those harmed.

In this appendix we offer a very short summary of our views, believing it is important for residents of the Basin to consider both perspectives as they make decisions about water-resource management and other issues that affect the Basin's economic outlook.

Our presentation focuses on just the three elements discussed below, a small subset of the factors shaping the Basin's economy during the past two decades. We emphasize that this rendition of our explanation is highly truncated and covers only the main points. We encourage those seeking a more detailed discussion to contact us directly (phone: 541-687-0051). The three factors are:

1. Contractions in the economic benefits (jobs and incomes) the Basin derived from the timber and agricultural industries stem more from trends and decisions within these industries than from environmental protections enacted by the federal government.
2. Reductions in logging on federal lands generated important economic benefits, as well as costs.
3. Much of the economic distress experienced in the Basin (and elsewhere in non-metropolitan counties of the West) stems from factors other than, and more powerful than, environmental-protection policies.

1. Contractions in Economic Benefits from Resource-Intensive Industries

We focus our discussion on the timber industry, because it is larger, but similar conclusions would apply if we looked at agriculture.

In 1990, the lumber-and-wood-products industry in Klamath County provided employment for 3,517 workers, 17 percent of the total, 20,164. By 1998, timber employment had declined to 2,714, which was 12.1 percent of the total, 22,341.

This and similar declines in timber employment elsewhere in the Pacific Northwest are commonly attributed to the declines in timber harvest occasioned by spotted owls, fish, riparian areas, and other environmental concerns, but a more fundamental reason is the essential character of the industry itself. The industry is mature, with few new products to excite consumers' interest, and each firm has strong incentives to lower its costs if it is to remain competitive in a global market. The cost-cutting pressures were especially strong until the 1980s, because the industry was highly unionized and had high labor costs relative to competitors elsewhere in the nation. For a long while, the industry was able to live with the higher costs because the lumber it produced came largely from old-growth trees with wood that had highly desired characteristics, such as strength and aesthetic appeal. Consequently, the region's mills were able to command a price premium relative to lumber produced elsewhere and used part of this premium to cover labor costs. As the supply of old-growth logs dwindled, however, so too did the price premium. At the same time, new technologies, such as highly computerized mills that could handle small logs with few workers, reduced the demand for labor.

As a result, in the 1980s the industry broke the unions[1], laid off thousands of workers and reduced the pay of those that remained. Table A.1 compares two peak years, 1979 and 1989. Historically, timber has been a highly cyclical industry and the number of workers per unit of timber processed varied widely from the cycle's peak to trough. In 1989, even though the amount logged in Oregon was 9 percent *higher* than in 1979, the number of employees was 17 percent *lower* and the total payroll (adjusted for inflation) was 32 percent *lower*.

Through the 1980s, and before there were noticeable environmental constraints on logging, the industry lowered its payroll (adjusted for

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[1] For additional discussion of the International Woodworkers of America and the structure of collective bargaining during the 1980s, see Widenor (1991; 1995).

inflation) per unit of timber by more than one-third. In other words, for each truckload of logs in 1989, timber workers in the region, as a whole, received paychecks that were less than two-thirds of those they had received ten years earlier. The pattern was similar in Klamath County, where employment in the lumber-and-wood-products industry declined 24 percent from 1979 to 1989, and inflation-adjusted payroll per employee declined 20.3 percent.

Table A.1: Declines in Payments to Timber[a] Workers in Oregon and Washington, 1979 vs. 1989[b]

	Change Between 1979 and 1989	
	Percent	**Amount**
Pacific		
Harvest (million boards feet)	3.7	545
Jobs in Lumber-and-Wood	-20.0	-27,047
Jobs per Million Board Feet	-22.9	-2.11
Payroll[c] per Timber Employee	-18.2	-$7,060
Payroll[c] per Million Board Feet	-37.0	-$131,787
Oregon		
Harvest (million boards feet)	9.4	726
Jobs in Lumber-and-Wood	-16.9	-13,712
Jobs per Million Board Feet	-24.0	-2.54
Payroll[c] per Timber Employee	-17.8	-$6,843
Payroll[c] per Million Board Feet	-37.6	$152,302
Washington		
Harvest (million boards feet)	-2.6	-181
Jobs in Lumber-and-Wood	-24.8	-13,335
Jobs per Million Board Feet	-22.8	-1.76
Payroll[c] per Timber Employee	-18.8	-$7,366
Payroll[c] per Million Board Feet	-37.3	-$112,959

[a] Timber refers to employment and payrolls in SIC 24, lumber-and-wood products.

[b] In the highly cyclical timber industry it is important to examine changes over time by looking at comparable parts of the cycle. The last two cyclical peaks are 1979 and 1989.

[c] 1997 dollars.

Source: ECONorthwest with data from the Oregon Department of Forestry (various years), the Oregon Employment Department (various years), the Washington Department of Natural Resources (various years), and Washington State Employment Security (various years).

This shift meant the industry, itself, markedly diminished its own role in the economy during the lead-up to actions that reduced federal timber harvests. Nonetheless, many in the region, including, ironically, the managers and workers in the industry who had implemented and felt the brunt of the industry's labor cutbacks, often failed to acknowledge both the industry's diminished role and the factors that brought it about.

A simple comparison provides insight into the importance of the reductions in federal logging, as a cause of the industry's shrinking contribution to the regional economy, relative to the industry's own actions. Between 1988, the year of peak harvests in the 1980s, and 1996, employment in the lumber-and-wood-products industry in Washington and Oregon declined by 24,104. Between 1979 and 1989, however, the timber industry eliminated 27,047 jobs (Oregon Employment Department various years; Washington State Employment Security various years). Even if *all* of the decline in the 1990s was attributable to spotted owls, salmon, and other environmental concerns—and elsewhere we demonstrate that it was not[2]—then environmental protection has eliminated fewer jobs than the industry's managers eliminated through their union-busting and cost-cutting during the 1980s.

Again, a similar pattern materialized in the Basin. From 1979 to 1989, for example, employment in the industry in Klamath County dropped by 1,143, but from 1989 until 1998, the decline was 1,029.

Furthermore, by the time environmental concerns contributed to the loss of timber jobs, the jobs no longer paid high wages. As Table A.2 shows, wages in the lumber-and-wood-products industry, which were among the highest in 1979, sharply declined by 1989, and increased slightly by 1996. Thus, even under worst-case assumptions, the logging restrictions on federal lands have posed less of a threat to timber workers than the industry's own actions to eliminate jobs and lower wages. Wages in other industries, especially high-tech, performed considerably better.

Of course, the industry's influence has been smaller in some parts of the region, and larger in others, with the Basin in the latter category. This does not mean, however, that the regional patterns described above do not apply here. Instead, the local economy has felt more intensely both the cost-cutting actions of the industry and the logging reductions associated with environmental protections. Given the regional trends in the industry, however, plus the inevitable declines in logging that would result because logging rates had been rapidly exhausting the supply of mature timber, it seems reasonable to conclude that the primary impact of the environment-related reductions in logging on federal lands was to move forward a contraction in the industry that would have occurred in any event.

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[2] Specifically, we show that logging reductions following a 1991 injunction to protect spotted owls probably resulted in the loss of fewer than 9,300 timber jobs in Oregon and Washington (Niemi, Whitelaw, and Johnston 1999).

Table A.2: The Lumber-and-Wood-Products Industry in the Pacific Northwest No Longer Pays High Wages[a]

	1979	1989	1996
Timber Employee Average Wage	$38,732	$31,672	$32,422
Manufacturing Employee Average Wage	$37,893	$36,212	$38,125
High Tech[b] Employee Average Wage	$32,678	$38,897	$59,762[c]

[a] All data in 1997 dollars.

[b] The Oregon Employment Department defines high tech as the office and computing machines industry (SIC 357), electronic equipment (SIC 36), instruments and related products (SIC 38), and the computer and data processing services (SIC 737).

[c] Oregon's payroll per employee for high tech was $47,622 in 1996; the PNW payroll per employee is higher because of the 19,747 employees in Washington's prepackaged software industry who average $140,260 a year.

Source: ECONorthwest with data from the Oregon Employment Department (various years) and Washington State Employment Security (various years).

2. Reductions in Logging Generated Benefits as Well as Costs

Numerous studies document logging's adverse spillover effects on the environment, by destroying habitat for some species, degrading water quality, disrupting hydrological cycles, and so forth. It also has had adverse spillover effects on the economy. Environment-related curtailments of logging reduced these spillover costs and, thus, generated benefits for the overall economy for additional information, see Niemi, Whitelaw, and Johnston (1999). Three types of reductions in spillover costs illustrate this conclusion:

(1) **Reduced unemployment-insurance subsidies**. Because the timber industry is highly seasonal and cyclical, workers are often out of work and receive unemployment benefits. In theory, the industry would pay unemployment-insurance premiums that fully cover the costs of the benefits paid. In practice, though, it has not and the excess costs have been borne by employers and workers in other sectors, reducing the disposable incomes of workers and business owners. Curtailments of logging reduced this burden, thereby stimulating growth in non-timber sectors of the economy. Relaxing the burden on other industries is important because, relative to the timber industry, they have a greater ability to generate new jobs and growth in incomes.

(2) **Reduced economic instability.** The instability associated with the timber industry's seasonality and cyclicality has caused numerous economic and social problems for families and communities. In particular, the boom-bust conditions over time often kept workers from pursuing careers in other industries, and

communities from pursuing economic diversification. During the timber industry's boom times, they were too busy; when the bust times appeared, they were too strapped. The permanent contraction of logging forced workers and communities to search for more opportunities. The transition is difficult, especially for older workers. Younger workers and communities able to diversify, however, should enjoy greater economic prosperity.

Recent developments offer evidence that diversification can occur in the Basin and provide encouragement that future diversification is possible. Klamath County in 2000 had five high-technology firms, with 226 employees. Increases in both the number of firms and the employment at existing firms are expected. All else equal, non-metro counties with high-quality, natural-resources amenities have strongly outperformed those with poor amenities, and several studies have determined the Klamath County has the potential to be among this group. The Basin also enjoys other advantages, including high-capacity optic fiber lines and proximity to rapidly growing economies to the north and west.

(3) **Reduced controversy.** The controversies over the environmental problems associated with logging eventually became millstones dragging down the state, regional, and local economies. Too many political, economic, and civil leaders were spending time on the controversies rather than on addressing other problems. The adoption of the Northwest Forest Plan and other decisions lessened the controversy and allowed these leaders to turn to other things.

3. Other Factors Contribute to the Basin's Economic Distress

Much of the attention regarding the Basin's economic history has focused on resources, institutions, and events within the Basin itself. More important for many residents, though, have been economic forces operating in the global, national, and regional economies. One of these stands out: the growing importance of education as a determinant of prosperity.

In the distant past, workers could increase their chances of enjoying higher earnings by moving closer to a major industry, such as the timber industry that paid above-average wages, even for unskilled workers. Over the past two decades, however, education has become more important than industry as a determinant of workers' expected, lifetime earnings. In 1980, male workers aged 25-34 with a college degree earned about 20 percent more than their counterparts having only a high school diploma. By 1990, this differential had increased to about 50 percent, and, by 1993, it was more than 70 percent (Dadres and Ginther 2001). Unskilled workers in general have been hit especially hard by this transition, seeing their inflation-adjusted wages drop across the nation and in all industries, including the timber industry.

What is true for workers is also true for communities. Those with a greater concentration of highly educated residents become more prosperous than those whose residents have lower levels of education. This rise in the importance of education seems to explain much of the Basin's growing economic problems over the past decade, and its failure to keep pace with the rest of the state.

According to the 1990 census, 23.8 percent of the residents of Klamath County, ages 25 years or more, had less than a high school education, and only 12.4 percent had four or more years of college education. Statewide averages, by contrast, showed only 18.5 percent with less than a high school education, but 20.6 percent with four or more years. of college (Reid and Flagg 1996). From these data, it seems likely that workers in Klamath County would have fallen behind workers elsewhere in the state (and especially those in the metropolitan areas and Deschutes County, where education levels are markedly higher), regardless of decisions to reduce logging on federal lands.

Recent trends are both troubling and hopeful. On the downside, tests of 10th grades in 1998 found that scores for Klamath County were below the statewide average for both reading and mathematics. Furthermore, only 34.4 percent of the county's recent high school graduates have enrolled in Oregon colleges and universities, whereas the statewide average is 42.1 percent (Reid and Flagg 1996). We recognize these numbers embody numerous ambiguities but, on their surface, they indicate that the county's educational achievements are failing to make up the gap that existed a decade ago.

On the upside, residents of the Basin have acted to turn things around, having recently approved the formation of a taxing district to support the formation of a community college. Many economic and educational leaders hope that the establishment of high-technology firms, fostered in part by educational and training programs extended by Oregon Institute of Technology will initiate a virtuous circle: more technology firms stimulates expanded technology education stimulates expansion of technology firms, etc.

SUMMARY

The Upper Klamath Basin's economic problems have many roots, which cannot be solved overnight or by addressing only some of the underlying causes. The brief discussion in this appendix demonstrates that curtailing the supply of logs to the timber industry was not the sole cause, or even a leading cause, of the Basin's poor economic performance relative to the rest of Oregon. Accordingly, the Basin's problems cannot be solved merely by increasing the allocation of forest resources to the timber industry.

The same is true for water and the agricultural industry. Because of the intensifying competition for resources, discussed in Chapter 1, any decision affecting the allocation of water resources will have both positive and negative impacts on the local economy. Hence, any decisions affecting the amount of water used for irrigation will entail tradeoffs—for individual farmers, the farming community as a whole, and the overall local economy. The tradeoffs, however, are not static, but shifting in a systematic, predictable way, and not in agriculture's favor. In contrast with the high-technology and other newcomer industries, the agricultural industry has been an important component of the local economy for decades, but its strength has been declining. Looking into the future, its ability to generate growth in jobs and incomes almost certainly will continue this long-standing, downward trend.

There is nothing unique about the Basin in this regard. In general, the local agricultural sector has followed national and regional trends, exemplified, for example, by data from the Bureau of Economic Analysis, which show that farm income as a percentage of total personal income in Oregon, has declined from nearly 4 percent in 1974 to less than 0.9 percent in 1998. We see no evidence supporting a turnaround in the industry's trends in the foreseeable future.

It is important to place these facts and trends in context. They do not mean that irrigated agriculture has no place in the Basin's economy. Far from it. Nor do they mean that agriculture is a bad industry or that farmers and ranchers should be singled out for blame for their industry's inability to generate growth in jobs and incomes.

Rather, we are saying that those trying to encourage greater prosperity in the Basin should carefully consider the tradeoffs associated with alternative uses of water and related resources before advocating one alternative or another. Furthermore, both the private and public sectors of the Basin's economy should look more closely than they have in the past at opportunities for capitalizing on strong national and regional economic trends. The evidence in this report shows that among the most powerful of these is the growing preference mobile families, workers, and firms have for locating in areas with high-quality natural-resource, social, and cultural amenities. Communities with such amenities consistently have higher growth in jobs and incomes than those whose economies focus on agriculture, timber, and other resource-intensive industries.

The Basin lies within two states and adjacent to communities fully engulfed in this trend and there are strong reasons to believe that, sooner or later, its influence will be felt here more strongly. There is no guarantee, of course, that the Basin will experience strong amenity-driven growth. It is clear, though, that how the Basin's water and related resources are managed can exert a strong influence. Our discussion in this report seeks to explain the economic importance of giving these issues full consideration and the potential consequences of alternative resource-management directions. Our recommendations explore ways for individuals and different groups to identify and implement win-win outcomes.

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