GOOSE AND SUMMER LAKES BASIN REPORT

State of Oregon

WATER RESOURCES DEPARTMENT

Salem, Oregon

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WATER RESOURCES COMMISSION

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INTRODUCTION

A. PURPOSE OF REPORT

The Water Resources Commission is responsible for managing the use and control of the state's water resources. The Commission sets water policy through a series of coordinated, interagency water resources programs pursuant to Oregon law (ORS 536.300 and 536.310). Each program deals with one individual basin. These programs are periodically reviewed and revised to reflect changing conditions.

The formulation of a water resources program for the Goose and Summer Lakes Basin was deferred after completion of an initial basin investigation in the 1960s. The decision reflected a judgement that there was little unappropriated water in the basin and that other areas were of higher priority. Since then, the Commission has twice considered proposals to establish minimum perennial streamflows on basin streams and has withdrawn from appropriation Thomas Creek; Dutchy, Church and No Name Lakes; and the main Fort Rock ground water reservoir.

This report is a support document for the water resources planning study in the Goose and Summer Lakes Basin. It discusses 17 issues which generally focus on low seasonal streamflows which adversely affect irrigation and fish habitat, the effects of timber harvest techniques on streamflows, erosion control, water quality and range conditions. The problems and issues were identified and prioritized by a citizens advisory committee and by federal and state resource management agencies. This report includes descriptions of the management strategy alternatives available to the Commission in addressing each of the problems and issues. Strategies are divided among those which the Commission can implement by rule, those requiring further study and work by the Department, and those which would be implemented by other organizations.

Two additional documents identify the decisions made on conclusion of the planning study. The basin plan contains policies and strategies addressing all of the issues discussed in the report. The plan identifies the agencies which should implement each of the selected management strategies. The basin program is an administrative rule. The rules govern future use and control of unappropriated surface and ground water in the Goose and Summer Lakes Basin. The program rules implement those management strategies in the plan that are within the regulatory jurisdiction of the Commission. Most other strategies in the plan would have to be implemented by other agencies.

B. PLANNING PROCESS

The planning process for the Goose and Summer Lakes Basin focused on three main elements: public participation, selected water resource issues and multi-agency cooperation.

A citizens advisory committee assisted the Water Resources Department in the planning effort. The committee helped select and prioritize the water resource issues and problems addressed in this report. The committee also assisted in developing the policies and

management strategy alternatives described in this report. Regular mailings were made to an extensive list of other interested citizens as well.

Other federal, state and local agencies were asked to cooperate in the planning effort. Many of the issues and management strategies cross jurisdictional boundaries. Only through cooperation can the proposed solutions be effectively implemented.

C. REPORT ORGANIZATION

This report is divided into 18 sections. The first section is a description of the physical, cultural and natural resources of the basin. The remaining sections discuss each of the issues and problems addressed during the planning study.

SECTION 1
GOOSE AND SUMMER LAKES BASIN OVERVIEW

A. PHYSICAL DESCRIPTION

1. GEOGRAPHY

The Goose and Summer Lakes Basin is composed of a large number of closed drainage systems in south-central Oregon. The streams in these drainages feed Goose Lake, the Warner Lakes, Lake Abert, Summer Lake, Silver Lake, and many named and unnamed playas. The basin encompasses an area of approximately 8,500 square miles. Parts of the Goose Lake and Warner Lakes drainages are in California and Nevada. Elevations in the basin range from 4,147 feet at Summer Lake to 8,456 feet on Crane Mountain.

The southern end of Goose Lake is the only point at which surface water may have flowed out of the basin in historic time. Unconfirmed reports suggest that Goose Lake overflowed into the North Fork Pit River in 1868 and 1881. Ground water may flow north from the Fort Rock area into the Deschutes River Basin and south from the Goose Lake area into the North Fork Pit River drainage.

For purposes of this report, the basin is divided into four subbasins: Goose Lake, Warner Lakes, Chewaucan, and Summer Lake. Streams within the Goose Lake and Chewaucan Subbasins drain to Goose Lake and Lake Abert, respectively. The Warner Lakes and Summer Lake Subbasins are composed of many closed drainages. While streams in the southern part of the Warner Lakes Subbasin drain to the Warner Lakes, there is no surface connection between many of the small streams in the northern part of the subbasin and the lakes. The Summer Lake Subbasin is made up of many small drainage systems. Except for Silver Creek and tributaries which flow to Silver Lake and the Ana River which flows to Summer Lake, the streams in the subbasin are intermittent and form a large number of small drainage systems which have no surface connection. Figure 1 is a map of the basin showing the subbasin boundaries. Table 1 shows the areas of the major surface drainages in the basin.

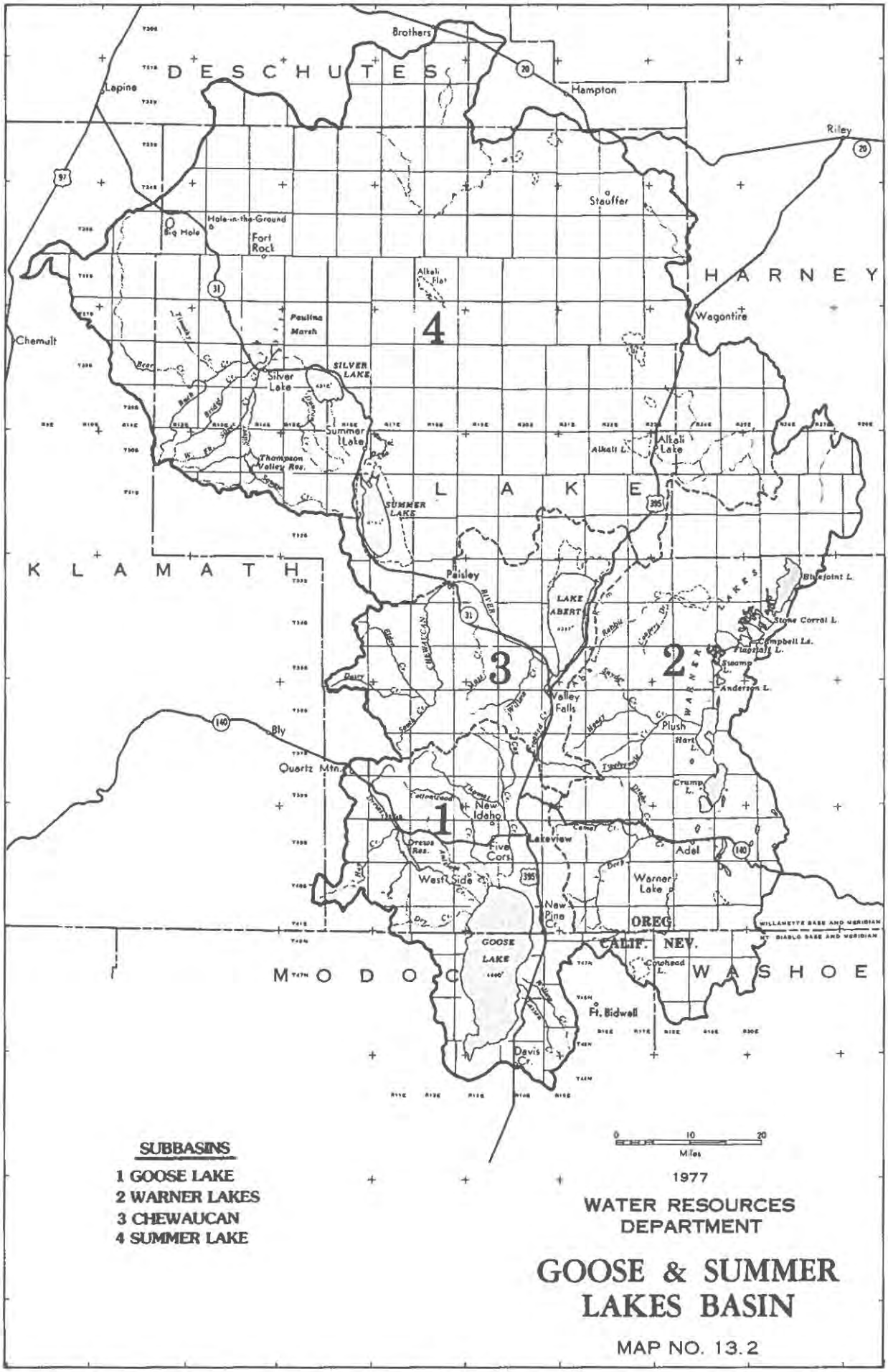
Soils in the basin are characteristic of those in other semi-arid eastern Oregon areas. About 40 percent are of the aridic/xeric frigid soils type. Native vegetation in these areas is low sagebrush, big sagebrush, bluebunch wheatgrass and Sandberg bluegrass. Xeric cryic soils are the other important type in the basin. Native vegetation on these soils includes ponderosa pine, lodgepole pine, white fir, quaking aspen, antelope bitterbrush and Idaho fescue. Figure 2 shows soils in the basin.

2. GEOLOGY

The Goose and Summer Lakes Basin lies within the northwest portion of the Basin and Range Physiographic Province. This province is characterized by intensely faulted terrain, tilted and uplifted fault-block mountains with prominent scarps, and closed drainage basins.

Major faults and uplifts have created a basin which is roughly triangular with the apex in California just south of Goose Lake. The faults trend generally north 35 degrees west on the west side of the basin and north 20 degrees east on the east side of the basin.

Figure 1



SUBBASINS

1 GOOSE LAKE
2 WARNER LAKES
3 CHEWAUCAN
4 SUMMER LAKE

1977

WATER RESOURCES DEPARTMENT

GOOSE & SUMMER LAKES BASIN

MAP NO. 13.2

Table 1
Major Surface Drainage Areas
(square miles)

	Oregon	California	Nevada	Totals
Goose Lake Subbasin				
Cottonwood Creek	95			95
Thomas Creek	230			230
Misc. Drainages	397	360		757
Total Area	722	360		1,082
Chewaucan Subbasin				
Chewaucan River	572			572
Misc. Drainages	267			267
Total Area	839			839
Warner Lakes Subbasin				
Deep Creek	284			284
Honey Creek	227			227
Twentymile Creek	143	41	73	257
Misc. Drainages	1,137		57	1,194
Total Area	1,791	41	130	1,962
Summer Lake Subbasin				
Silver Creek	524			524
Summer Lake	447			447
Misc. Drainages	3,835			3,835
Total Area	4,806			4,806
Basin Totals	8,158	401	130	8,689

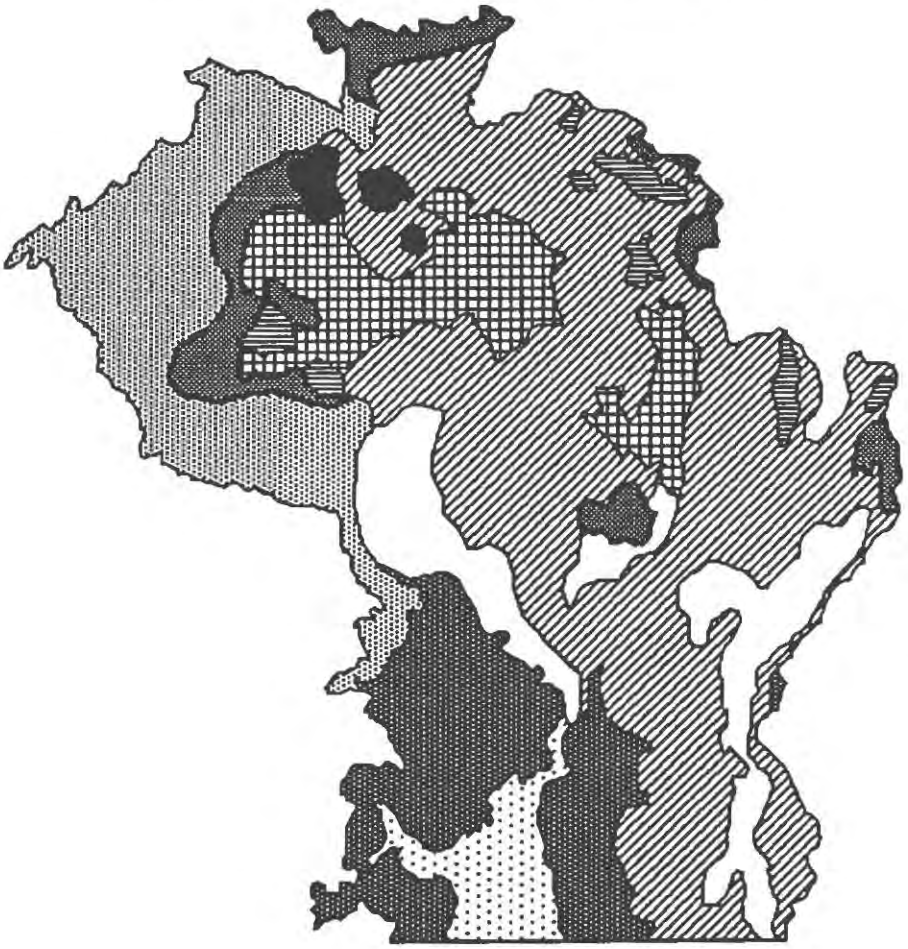
Source: Oregon Water Resources Department

The main fault system appears to have developed during Pliocene time (13 to 5 million years ago), and faulting has continued sporadically into recent time. Cinder cones, volcanic vents and rhyolite plugs, dikes and domes dating from the late Pliocene and early Pleistocene (5 to 2 million years ago) are found throughout the basin. These structures and associated lava flows have combined with faulting and folding to disrupt surface and subsurface drainage patterns.

Ancient lake deposits and valley fill sediments have often obscured structural features in the valleys. Valley fill near the east side of Goose Lake is reported to be about 5,000 feet thick, and decreases in thickness to the west.

During Pleistocene time, large lakes filled the Summer, Warner and Fort Rock basins. During the same time, Goose Lake overflowed into the Pit River. As time passed, the climate became drier, and most of the lakes evaporated. The present lakes and playas are all that remain of these ancestral lakes. With no surface outlets, saline concentrations have risen until now most lake waters in the basin are too salty for domestic or irrigation use.

Figure 2
Goose and Summer Lakes Basin Soils



Legend
(abbreviated from source map)

- Xeric Cryic Soils of High Plateaus
- Xeric Cryic Soils on Pumice Plateaus
- Aquic Frigid and Cryic Soils of Basins and Valleys
- Xeric Mesic Soils on Flood Plains and Terraces
- Xeric/Aridic Frigid Soils on Uplands
- Aridic/Xeric Mesic Soils on Flood Plains and Terraces
- Aridic/Xeric Frigid Soils on Terraces and Plains
- Aridic/Xeric Frigid Soils on Plateaus and Uplands
- Lava Flows

Source: Oregon Water Resources Department, 1987; from U.S. Soil Conservation Service, General Soils Map 4-B-39693, 1986

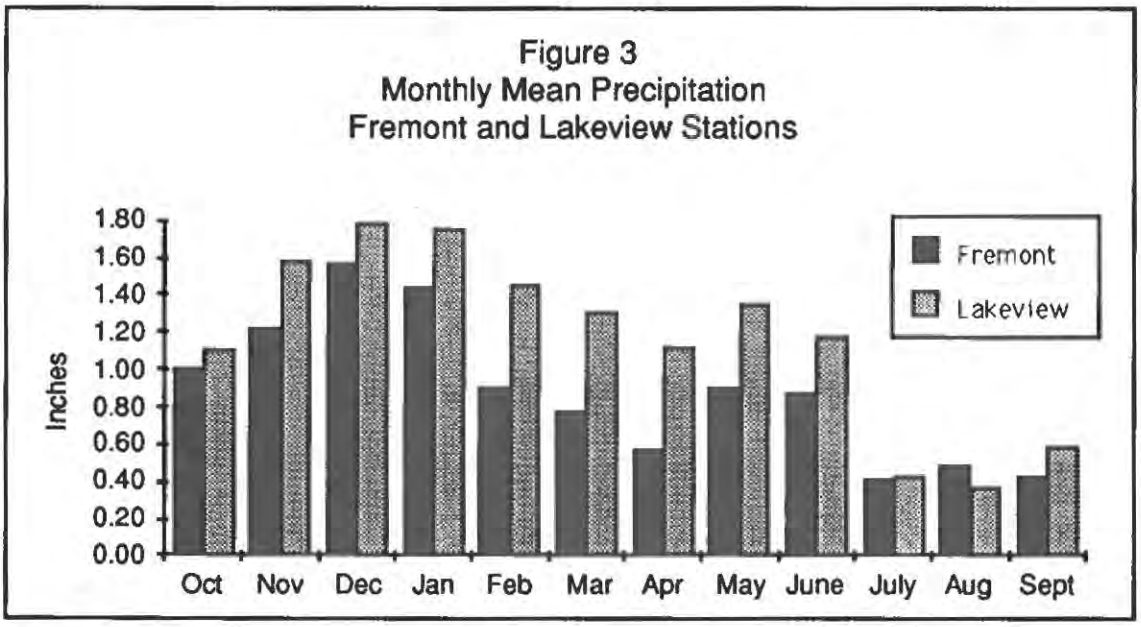
3. CLIMATE

The basin climate is semiarid. Average annual precipitation ranges from 5 inches in some of the valleys to over 30 inches at higher elevations. Table 2 shows long-term annual average precipitation at several measurement locations in the basin. As is typical of West Coast areas, most of the precipitation falls during the winter. During the June through August growing season, average annual precipitation at lower elevations is only about 2 inches. Figure 3 shows the monthly distribution of rainfall at the Lakeview and Fremont stations.

Table 2
Mean Monthly Precipitation at Selected Stations
(inches)

Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Total
Alkali Lake	0.70	0.79	0.71	0.75	0.46	0.58	0.71	1.07	1.50	0.48	0.59	0.42	8.75
Fremont	1.02	1.23	1.57	1.44	0.90	0.77	0.58	0.91	0.88	0.42	0.49	0.43	10.65
Lakeview	1.12	1.59	1.79	1.76	1.45	1.32	1.13	1.36	1.19	0.43	0.38	0.59	14.10
Plush	0.61	0.62	0.54	0.47	0.46	0.46	0.37	1.03	0.93	0.32	0.24	0.39	6.44
Populars	0.74	1.12	1.28	1.22	0.70	0.65	0.56	1.23	1.26	0.57	0.48	0.32	10.12
Valley Falls	1.02	1.11	1.34	1.19	1.24	1.01	0.98	1.37	1.21	0.49	0.36	0.57	11.91
Wagontire	0.67	1.23	1.05	0.73	0.53	0.56	0.64	0.83	0.74	0.36	0.62	0.49	8.45

Source: Oregon Water Resources Department



Average minimum and maximum monthly temperatures at the lower elevations in the basin range from 18° to 37° F in January and from 49° to 85° F in July. Frost-free periods average 122 days in the open valleys, except in the Fort Rock/Christmas Valley area where the frost-free period is shorter. Freezing temperatures can occur at any time during the year.

4. LAND USE

Almost three-quarters of the basin is classified as range land. Most of the remaining area is forest land located at the higher elevations along the western boundary of the basin and in the south-central part of the basin. Less than four percent of the land is cultivated. Table 3 shows the basin land use classifications by county.

Table 3
Land Use Classifications by County
(acres)

Land Use Type	Lake	Deschutes	Harney	Klamath	Total
Irrigated Agriculture	122,622	0	0	177	122,799
Non-irrigated Agri.	72,696	0	0	0	72,696
Range	3,070,364	141,049	376,093	3,983	3,591,489
Forest	750,746	32,545	778	147,237	931,306
Urban	5,297	0	0	0	5,297
Water	129,255	0	0	112	129,367
Other	231,740	483	4,569	171	236,963
Totals	4,382,720	174,077	381,440	151,680	5,089,917

Source: Oregon Water Resources Department, 1980

5. HYDROLOGY

Rain and snow recharge the surface and ground water systems seasonally. When changing conditions result in reductions in recharge or increases in the supply of either the surface or ground water, corresponding changes in the other are likely. For example, when the ground water supply is depleted, discharge to lakes and tributary streams decreases and the lakes shrink. During periods of low precipitation, infiltration of water decreases and ground water levels decline.

a) Surface Water

1) Quantity

Most of the basin's water supply originates on the mountains lying along the western boundary of the basin and on the Warner Mountains. Most of the streams draining these upland areas flow into one of the major lakes on the valley floors. Peak discharge on most streams is in May. Discharge during this period is derived primarily from melting snow. The low flow period generally occurs during August and September. There are no permanent snowfields in the basin. Flows during the late summer and fall are supplied by springs and seeps. Table 4 shows the average monthly discharge for several gaged streams in the basin.

The northeastern half of the basin is drained by intermittent streams which are dry except for brief periods following rainfall or snow melt. These streams discharge into numerous small playas where the waters either evaporate or percolate to ground water.

Table 4
Average Monthly Discharge for Selected Streams
(cfs)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
Camas Creek	9	14	33	30	41	64	164	144	42	10	5	5
Chewaucan River	39	54	88	88	112	160	338	494	252	62	31	31
Cottonwood Creek												
before reservoir	3	12	11	10	14	61	94	69	36	10	4	3
after reservoir	3	3	6	6	8	15	41	55	44	31	20	9
Drake Creek	7	7	9	17	27	34	36	15	9	7	7	6
Deep Creek	24	40	82	86	115	178	398	429	203	34	13	15
Drews Creek	3	3	12	20	41	94	160	114	56	51	40	21
Honey Creek	4	7	22	22	30	50	96	122	50	9	2	1
Thomas Creek	1	7	12	9	33	35	51	58	15	2	1	1
Twentymile Creek	7	9	32	52	73	134	133	97	56	10	3	3

Sources: U.S. Geological Survey, 1984 and Water Resources Department, 1986

2) Quality

Water quality standards in the basin generally are met. Headwater streams nearly always have good water quality. However, many streams on the valley floors exhibit low dissolved oxygen and high turbidity levels. Spring runoff is naturally muddy. Several reservoirs in the basin are shallow and on colloidal soils. As a result, solids are kept in suspension in the reservoirs and contribute to poor water quality downstream. In addition, elevated levels of coliform bacteria concentrations have been measured in many streams including Kelly, Drews, Cottonwood, Thomas, Cox and Crooked Creeks and the Chewaucan River. There is not a sufficient quantity of data to know if the problems are recurrent. Water temperatures during low-flow periods are naturally high. Temperatures as high as 75° F. have been measured on the Chewaucan River and 70° F. temperatures have been recorded at many other monitoring sites in the basin.

The waters of most major lakes in the basin are alkaline and saline. Abert, Summer and Goose Lakes are not suitable for most uses including irrigation. Water is pumped from Crump and Hart Lakes for irrigation use. Table 5 shows the levels of alkalinity and electrical conductivity (a measure of salinity) for the waters of the major lakes and reservoirs in the basin.

b) Ground Water

1) Quantity

Substantial supplies of ground water probably are available in most areas of the Goose and Summer Lakes Basin. Most aquifers can furnish water for a number of years at the present level of development and use. However, recent studies indicate that pumping in some areas is at or near the maximum level which can be sustained without significantly depleting the resource. Additional studies are needed to assess accurately the amount of ground water in the basin and to identify the rate at which ground water can be used without depleting the resource.

Table 5
Lake Water Quality Data

Name	Alkalinity (mg/l)	Conductivity (µmhos/cm)
Abert Lake	11,515	42,000
Cottonwood Reservoir	31	62
Crump Lake	64	142
Dog Lake	42	85
Drews Reservoir	42	85
Goose Lake	904	2,075
Hart Lake	97	205
Summer Lake	2,649	7,000
Thompson Valley Reservoir	23	49

Source: Johnson, Peterson, Lycan, et al., 1985

Water occurs in unconfined and confined aquifers beneath the entire basin. Depending on recharge conditions and the tightness of the confining layers, the depths to useable quantities of water vary significantly. For example, most wells in the Fort Rock area are from 200 to 500 feet deep. Conversely, many flowing wells have resulted from drilling into relatively shallow, confined aquifers. Some of these wells have continued to flow. Others ceased flowing as irrigation use increased. The presence of the many marshes in the basin indicates that unconfined ground water is within 10 to 20 feet of the surface at locations throughout the valleys.

2) Quality

Ground water in the basin generally is of good quality. However, some wells and springs, particularly those which are near the major faults, produce hot and/or poor quality water. Three wells drilled near Paisley encountered water in excess of 200° F—too hot for irrigation use. Alternatives for use of this geothermal resource are being investigated. Several wells in the Lakeview area provide hot water which is used for space heating. The geothermal water in the Lakeview area contains elevated levels of manganese, boron and sulfates. There is some mingling of the geothermal water with water in the valley aquifer to the west.

Boron, iron, sulphur, alkali and other impurities are found in ground water at some locations, both from lake bed sediments and from volcanic materials. Some organic interbeds also have yielded non-potable brackish water. For example, a well on the ZX Ranch south of Summer Lake encountered saline water at a depth of 1,200 feet. The well produced fresh water when it was sealed to within 400 feet.

The differing characteristics of the water produced by wells in the basin indicate that the ground water system is highly variable. Impermeable, or almost impermeable, beds interfinger with aquifers with water quality varying from potable to toxic. Consequently, great care must be taken when developing a well to ensure that toxic or brackish water does not contaminate fresh water aquifers.

Ground water in two areas in the basin has been contaminated. A chemical waste disposal site was operated near Alkali Lake between 1969 and 1971. During that period, a total of 25,000 drums of wastes, primarily from the manufacture of herbicides, was stockpiled at the site. In 1976, the site was purchased by the state and most of the barrels were crushed and

buried in shallow, unlined trenches. Since then, a plume of contaminated ground water has grown to the west of the burial site. Under present climatic conditions, contamination of deeper aquifers is unlikely because the area is a ground water discharge area.

Residues from the uranium mill tailings site at Lakeview also have leached into shallow ground water. Monitoring wells have shown a plume of contaminated ground water to the west of the tailings site. The contaminants include arsenic, sulfates, chlorides, and nitrates. While the tailings have been removed, no decision has been made regarding the need for aquifer restoration.

B. CULTURAL DESCRIPTION

1. HISTORY

The Goose and Summer Lakes Basin is rich in prehistory. In the past, this area offered much richer marsh and lake resources for human use. The number of surface sites and cave sites in the area suggest that human occupation of the lake-marsh environment was ancient and widespread. Many sites are found in lands that were the shores of ancient lakes. There has been a fairly continuous use of the basin by native people from around 13,000 years ago to historic times. The site distributions reflect changing lake levels and gradual drying up of the region. As the climate changed, lake-dependent people withdrew from the region and were replaced by the Northern Paiute.

The eastern shore of Lake Abert is a National Register Archaeological District. The lake shore was intensely occupied over the last 5,000 years. During that time the lake was larger, and fresher, and the people living along the shore appear to have been more sedentary than the Northern Paiute who occupied the region in historic times.

The Warner Valley area would have offered a variety of plants, waterfowl, fish, and small and large game to early inhabitants. These early people wintered in large, well-defined villages and dispersed in the summer. This moving population would have taken advantage of the mosaic of resources that shifted in relative proximity throughout the year.

Available archaeological information indicates that a marsh- and lake-dependent way of life was followed in the basin for thousands of years. Only minor variations in material culture, resource utilization, and settlement patterns occur. Each of the archaeological sites in the basin has considerable potential for adding to an understanding of regional prehistory.

Parties sent out by the federal government and the Hudson Bay Company explored the region in the first half of the nineteenth century. Following the discovery of gold in the John Day and Powder River regions in the 1860s, the area was traversed by prospectors. In 1867, Camp Warner was established near Honey Creek. It was not until 1869, however, that the first homesteaders settled in the basin.

Early agriculture was based on use of meadows in the open valleys for stock grazing. This is still the principal agricultural activity in the basin. Early settlers depended upon natural flooding of meadowland to produce hay for winter forage. The major agricultural lands north of Goose Lake, in the southern part of the Warner Lakes Valley, and along the Chewaucan River once were marsh lands. During the late 1800s and early 1900s, local farmers developed drainage and irrigation systems to increase hay yields and improve pasture.

A period of rapid settlement occurred in the Fort Rock/Christmas Valley area between 1905 and 1915. However, most of the homesteads were based on dry-land farming and had been abandoned by 1920 because of the drought. Agriculture expanded rapidly in the area again in the 1970s with increased ground water use. As many as 65,000 acres were placed under irrigation, primarily for alfalfa production. Recent economic conditions have resulted in reductions in the amount of irrigation in the area.

2. POLITICAL SUBDIVISIONS

Most of the Goose and Summer Lakes Basin is in Lake County. Very small areas of three other Oregon counties are in the basin. These are Deschutes, Harney, and Klamath Counties. In addition, the Goose Lake and Warner Lakes drainages extend into Modoc County, California. The Warner Lakes drainage also extends into Washoe County, Nevada. Table 6 shows the basin land area by county. There are only two municipalities in the basin. These are Lakeview in the Goose Lake Subbasin and Paisley in the Chewaucan Subbasin.

Table 6
Basin Land Area by County
(square miles)

County	Area	Percent of Basin in County*
Deschutes	272	3
Harney	596	7
Klamath	237	3
Lake	6,848	81
Modoc	401	5
Washoe	130	2

* Does not add up to 100 due to rounding.

Source: Oregon Water Resources Department

3. POPULATION AND DISTRIBUTION

The population of the basin is approximately the same as that of Lake County—about 7,600. Approximately one-half of the people in the basin live in the Lakeview area. Most of the remainder live in and around the City of Paisley and the unincorporated communities of Adel, Christmas Valley, Fort Rock, New Pine Creek, Plush, Silver Lake and Summer Lake. The population of Lake County increased by 21 percent between 1940 and 1986. This compares to a statewide population increase of 144 percent during the same period. Table 7 shows historic population figures for the county and two cities.

4. LAND OWNERSHIP

a) Federal

The federal government owns approximately 6,800 square miles in the Goose and Summer Lakes Basin. This comprises 85 percent of the basin area. Most of these lands are managed by the Bureau of Land Management. The Forest Service and Fish and Wildlife Service also manage lands in the basin.

Table 7
County and City Populations

	1940	1950	1960	1970	1980	1987
Lake County	6,293	6,649	7,158	6,343	7,532	7,300
Lakeview	2,466	2,831	3,260	2,705	2,770	2,790
Paisley	237	214	219	260	343	335

Sources: Oregon Blue Book and Portland State University Center for Population Research and Census

b) Other Public

The State of Oregon owns approximately 200 square miles in the Goose and Summer Lakes Basin. This comprises 2 percent of the basin area. The Division of State Lands, Parks and Recreation Division and Departments of Fish and Wildlife and Forestry are responsible for management of the state-owned lands.

c) Private

Privately-owned lands generally are concentrated in the valley bottoms. Three cattle ranches, the MC near Adel and the ZX and J-Speer near Paisley, own large acreages in the basin. Weyerhaeuser Company owns timberlands along the western boundary of the basin.

5. ECONOMY

Lumber, government and agriculture form the economic base for Lake County which makes up most of the Goose and Summer Lakes Basin. Government is second only to investment income as the largest source of personal income in the county. The private economy revolves around lumber mills, mill work and ranching based on livestock, hay and grain. Table 8 lists the major sources of income in the county.

Table 8
Personal Income by Major Sources
Lake County

Source	Amount
Dividends, Interest, Rent	$17,945,000
Government	17,135,000
Transfer Payments	13,729,000
Manufacturing	13,076,000
Farm	9,108,000
Trade	4,782,000
Services	3,849,000
Transportation & Utilities	1,798,000
Construction	1,846,000
Finance, Insurance, Real Estate	745,000
Total	$82,238,000

Source: Oregon Employment Division, 1986

During the past several years, Lake County per capita income has declined relative to per capita income of the state as a whole. The state Employment Division attributes the decline to the long-term relative deterioration in farm income and the lack of industrial diversification, along with a steadily increasing trend towards automation in the lumber and wood products industry.

C. RESOURCES

1. AGRICULTURE

In 1982, approximately 830,000 acres in Lake County were privately-owned farm lands. About 62 percent of the farm lands were classified as pasture and range and 24 percent were classified as croplands. Most of the croplands are devoted to the production of alfalfa, other hay crops and mint. Most of the alfalfa and mint production is in the Fort Rock/Christmas Valley area and is irrigated from ground water. Most of the pasture and grass hay is irrigated with surface water. Less than 10 percent of the croplands are used for grains and specialty crops. The sale of crops accounted for 42 percent of Lake County farm income in 1985 and 28 percent in 1987. Virtually all of the remaining farm income came from livestock. The decline in the contribution of crop sales to total farm income is due to the enrollment of lands in the Conservation Reserve Program and declining alfalfa prices.

As of September 1987, over 15,000 acres of land in Lake County had been enrolled in the Conservation Reserve Program. This program funds the setting aside of erosion-prone agricultural land for 10 years. It also requires the planting of vegetative cover on these lands. Although not all the Lake County acreage is irrigated, the program will result in a reduction of the basin's irrigated land for the reserve period. By law, water rights for lands enrolled in the program are not considered abandoned and cannot be cancelled because of non-use.

2. FORESTRY

Commercial timberlands make up about one-third of the Goose and Summer Lakes Basin. Ponderosa pine represents the majority of commercial growing stock and sawtimber in the basin. White fir represents the second most productive species. Virtually all of the manufacturing employment in the basin is in lumber and wood products. Largely because of federal requirements that much of the timber in the basin be milled in Lakeview or Paisley, the area has not experienced the volatile conditions in the lumber market which has been experienced in many other areas of the state.

3. FISH AND WILDLIFE

The Goose and Summer Lakes Basin provides important habitat for a variety of fish, waterfowl, and wildlife species. Streams and headwater lakes in the basin support populations of several species of game fish including redband trout, rainbow trout, brook trout, brown bullhead, catfish, largemouth bass and crappie. Other warm-water game fish found in the basin include bluegill sunfish, yellow perch, pumpkinseed sunfish, channel catfish, and white-striped hybrid bass. The Department of Fish and Wildlife also stocks 38,000 catchable-size rainbow trout in the basin each year. In the early 1960s, crappie were introduced into the Warner Lakes. The populations have grown since then and the species now provides an important recreational resource in the Basin. However, crappie are predators and subsequent declines in trout and Warner sucker populations are, in part, due to the presence of crappie.

Non-game fish species found in the basin include Warner sucker, Goose Lake sucker, Fosket Spring speckled dace, Hutton Springs tui chub, Summer Basin tui chub and Pit sculpin. The Warner sucker, Fosket Spring speckled dace and Hutton Springs tui chub have been federally designated as threatened species.

The basin is a natural resting and wintering area for thousands of ducks, geese, swans and other waterfowl migrating along the Pacific flyway. There is a waterfowl management area at Summer Lake. The Warner Lakes, Lake Abert and Goose Lake also provide important habitat areas for waterfowl.

Mule deer use the lower areas of the basin as winter range and the higher areas as summer range. Important deer habitat is in areas northeast of Fort Rock, Silver Lake, Crooked Creek, and southwest Warner Valley. The Hart Mountain National Antelope Refuge is on the eastern boundary of the basin. Pronghorn antelope also use habitat on the west side of Alkali Lake, on Abert Rim and west of Plush.

4. MINERALS AND ENERGY

Past mineral production in the basin included the following: borates, cinders, diatomite, gemstones (agate, jasper, obsidian, petrified wood, precious opal and sunstone), gold, mercury, perlite, sand and gravel, stone and uranium oxide. Mining of diatomite presently provides employment in the Christmas Valley area. The Krone Hill-Quartz Butte gold exploration project may have significant economic impacts on Lakeview. Gold exploration drilling and other exploration methods are being conducted throughout the basin.

There are four known geothermal resource areas in the basin. Several wells in and around Lakeview produce hot water from the fault system fronting the Warner Mountains. A small amount of water is used for space heating in the area. There has been no large-scale use yet, so the full extent of the resource is not known. A 1981 analysis of the geothermal reservoir potential by Hydrosciences, Inc. indicated that the volcanic-fracture system is in contact with the valley fill aquifer system, and that pumping at a high rate from a single well affects other wells in the vicinity. The Newberry Crater area northwest of the basin is under consideration for commercial geothermal development. Although all exploratory wells developed to date have been outside the basin, areas within the basin are under lease for exploration. The resource at Summer Lake currently is used to supply a swimming pool. There appears to be no interest in developing the resource at Crump Lake.

Two uranium mines—the White King and Lucky Lass—were operated in the Fremont Mountains north of Lakeview between 1955 and 1960. Declining uranium prices and the costs of keeping the mines free of water were the primary causes of abandonment of the mines. The mine pits currently are full of water with high concentrations of arsenic. Overflow from the mine pits drains to Auger Creek. An associated processing mill was constructed at Lakeview. Removal of the large tailings pile which was left when the mill closed was completed in 1987. The Oregon Department of Energy will evaluate the need for restoration of the aquifer which was contaminated by the tailings.

5. RECREATION AND TOURISM

Recreation in the basin is enhanced by the diversity provided by water-dependent and water-related activities. The predominant recreational activities are fishing, hunting, rock-hounding, and nature viewing. Given the semiarid climate in the basin, water is a definite

attractor of recreational activities. Of the fifteen public parks in the area, only two parks do not show fishing as one of the primary recreational features (ODOT, 1984).

The Goose Lake Subbasin contains a number of recreational sites. The Goose Lake Recreation Area at New Pine Creek is used primarily during the summer months by local residents for swimming, and by tourists for short-term camping. However, the shallow depth of the lake and afternoon winds create gray, turbid water that many consider unappealing. Boating and camping use increases with the onset of goose and duck hunting seasons. Maintaining the waterfowl habitat is particularly important for the recreation area. Pine Creek, the only spring-fed stream associated with the area becomes a dry creek bed in early summer because of upstream diversion of water.

Other recreation areas within the subbasin include Chandler Wayside, Thomas Creek, Cottonwood Meadows Reservoir, Dog Lake and Drews Reservoir. Chandler Wayside is an older, well-used wayside. Crooked Creek is accessed from the wayside. This stream is heavily fished in the spring, but flows generally are too low during other seasons to support fishing. Thomas Creek was assessed as having substantial resources for trout fishing and other recreational opportunities in the Pacific Northwest Rivers Study (PRD, 1987). Cottonwood Meadows Reservoir supports a summer camp and a public campground. The reservoir is heavily fished and has a boat dock. Dog Lake has two public camps. The site is known for the waterfowl nesting habitat provided by the marshes lining the shore. Productive lakes, such as Dog Lake, with quality, undisturbed marsh vegetation in the basin are rare and none are fully protected (Nature Conservancy, 1975). The lake has been expanded through construction of a dam at the outlet. Drews Reservoir is one of the few water bodies in the area where water skiing occurs. The fishing in the reservoir is reported as good and the campground is well-used.

The shallow lakes and fringe marshes in the Warner Lakes Subbasin provide one of the few large, significant waterfowl and shorebird production areas in southeast Oregon (Nature Conservancy, 1975). Many of the lakes are heavily used for crappie fishing. The channels between the lakes are used for both waterfowl hunting and fishing. This area is the main route to Hart Mountain. The Warner Lakes and wetlands are a high quality scenic resource. The subbasin also contains a recreationally important sunstone deposit. An area of two square miles is open to public collecting. Rockhounds from throughout the United States visit the area.

The Chewaucan River, which drains a large portion of the Chewaucan Subbasin, was assessed as having outstanding recreational resources as a trout fishing stream in the Pacific Northwest Rivers Study (PRD, 1987). The river also was identified as having substantial resources for other recreational activities such as hiking, nature viewing and camping.

In the Summer Lake Subbasin, hunting of snow and Canada geese and ducks is the primary water-related recreational activity. This activity is enhanced by the presence of the state Game Management Area at Summer Lake. Other recreational opportunities in the subbasin include Ana Reservoir which supports some fishing and Summer Lake Hot Springs which has a hot springs pool and recreational vehicle park.

D. WATER USE AND CONTROL

1. WATER RIGHTS

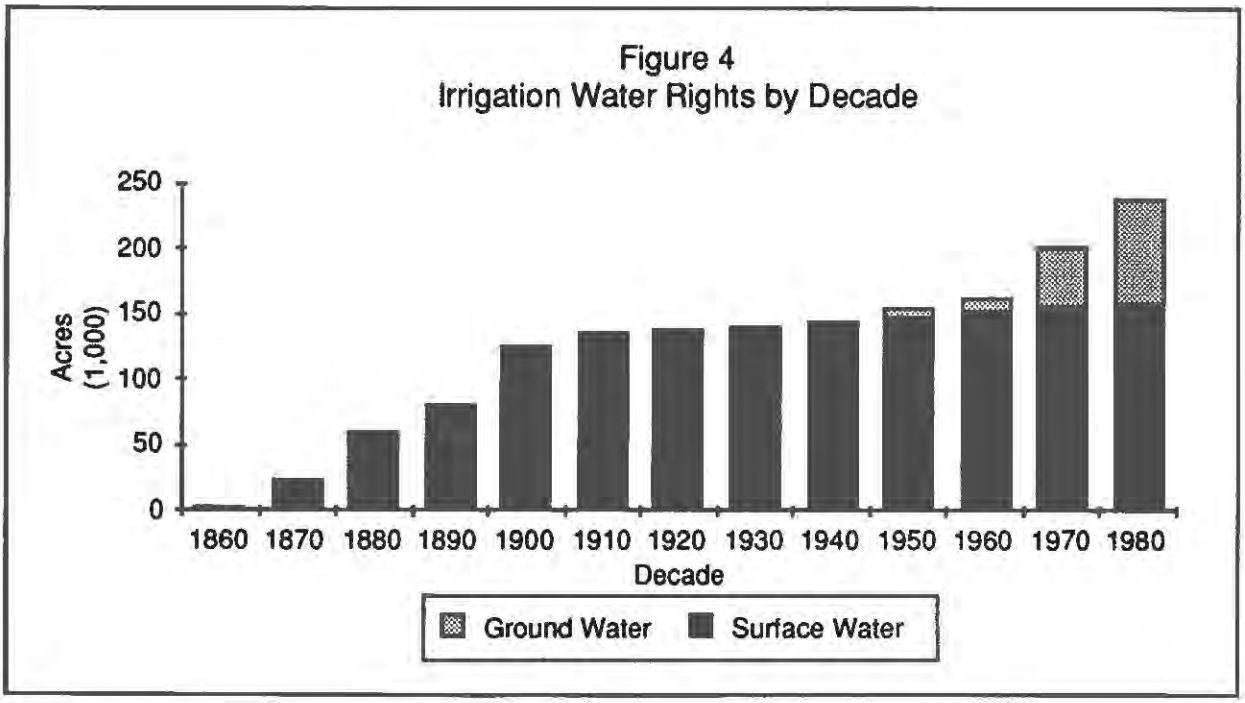
a) Certificates and Permits

The major water use in the Goose and Summer Lakes Basin is irrigation. There are rights to irrigate over 183,000 acres in the basin. (See Table 9) There are supplemental rights for about 33,000 acres of these lands. Supplemental rights allow users to divert water only to make up for a shortfall in their normal supply. If the normally allowed rate is applied (see Adjudications, below), diversions for irrigation could total nearly 4,600 cubic feet per second (cfs). The priority dates of water rights for irrigation of lands in the basin indicate a period of rapid expansion in surface water use between 1860 and 1900 followed by slow, but steady growth. Few water rights for ground water use were issued prior to 1960. Since 1960, dramatic expansion of ground water use has occurred. Figure 4 shows the increases in irrigation water use.

Table 9
Irrigation Water Rights Acres

Subbasin	Surface Primary	Surface Supplemental	Ground water Primary	Ground water Supplemental	Totals
Goose Lake	38,984	5,226	8,138	3,133	55,482
Chewaucan	19,548	309	2,930	349	23,136
Warner Lakes	30,718	18,631	598	1,232	51,180
Summer Lake	16,462	3,646	65,777	866	86,750
Totals	105,712	27,812	77,444	5,580	216,549

Source: Oregon Water Resources Department



The land use inventory conducted by WRD in the early 1980s showed approximately 123,000 acres of irrigated lands in the basin. The 60,000 acre difference between the water rights summary and the land use inventory may reflect abandonment of older rights or land use classification errors.

The three irrigation districts in the basin serve nearly 16,000 acres. These districts are the Lakeview Water Users, Inc. in the Goose Lake Subbasin and the Silver Lake Irrigation District and Summer Lake Irrigation District in the Summer Lake Subbasin.

Two cities have municipal water rights in the basin. Water for Lakeview (6.68 cfs) is supplied through groundwater and springs. Paisley obtains its water (0.57 cfs) from two wells. Other important uses include over 100 cfs for wildlife in the Summer Lake Game Management Area and 44 cfs for fish. Both of these uses are in the Summer Lake Subbasin.

About 42 percent of the irrigation water rights have ground water sources. About 85 percent of the acreage irrigated with ground water is in the Summer Lake Subbasin. Most of this use is in the Fort Rock area and is for primary irrigation. About three-quarters of the ground water permits in the Goose Lake area are for primary irrigation and one-quarter for supplemental irrigation. Supplemental appropriations may be made only after the primary source—typically a surface supply—has been exhausted. Consequently, most ground water rights in the Fort Rock area are used throughout the irrigation season. Many wells in the Goose Lake Subbasin only are used late in the season when surface supplies are inadequate.

Studies of ground water availability and use have shown that use of ground water in the Goose Lake and Summer Lake Subbasins generally exceeded natural recharge until about 1981. In the Goose Lake Valley, ground water declines of up to 13 feet occurred between 1972 and 1981. Rates of decline varied from 0.5 to 3.0 feet per year, averaging about one foot per year. Reductions in the numbers of acres irrigated since 1981 have resulted in a slight recovery in water levels, but not to pre-pumping levels. The capacity of the aquifer to provide water for all existing rights without depletion has not been established.

In the Fort Rock/Christmas Valley area of the Summer Lake Subbasin, steady increases in ground water use between 1972 and 1981 resulted in a rate of withdrawal which exceeded natural recharge. As a result, declines in ground water levels occurred. Estimates indicate that an annual pumpage of 80,000 acre-feet of ground water can be sustained in the area. However, with this rate of use, restoration of long-term equilibrium in the recharge/discharge balance may take more than 100 years. During this period, water levels could decline up to 70 feet. This decline is expected to result in reduced subsurface discharge to the Deschutes River Basin and Summer Lake area and reduced evapotranspiration by native vegetation in the Fort Rock area.

Other important uses in the basin are fish and wildlife (480 cfs), municipal-industrial (51 cfs), and non-irrigation agriculture (27 cfs). The basin also has very limited amounts of water appropriated for power, domestic, commercial, and recreation.

b) Adjudications

Although there have been 8 adjudications in the basin, the basin is not entirely adjudicated. Most major drainage systems have been adjudicated (see Table 10). However, several areas—primarily those with small, intermittent streams—are not covered by any court decree. In most areas, irrigation seasons begin April 1 and end in September. Generally, the allowed rate is 1/40 cfs per acre. Usually no more than three acre-feet per acre may be applied during the irrigation season.

2. WATER USE RESTRICTIONS

a) Statutory

Appropriation and use of water in the Goose Lake Subbasin is subject to the provisions of the Oregon-California Goose Lake Interstate Compact. The compact was ratified by the Oregon and California Legislatures in 1963. Congress consented to the compact in 1984. The compact is in ORS 542.520.

The compact prohibits the export of water from the Goose Lake Subbasin for use outside the subbasin without prior consent of both state legislatures. The compact also permits the construction and operation of storage and diversion facilities in one state to supply uses within the basin in the other state. The construction, operation, repairs, and replacement of any such facilities are subject to the laws of the state in which the facilities are located.

b) Administrative

1) Classification

The Water Resources Commission is given authority to classify and reclassify all sources of water supply within the state as to the highest and best use. Appropriation of water is limited to the uses for which the source of water is classified. These classifications are established in basin programs. In those basins for which basin programs have not been adopted, surface and ground water may be appropriated for any beneficial use. A basin program has not been adopted for the Goose and Summer Lakes Basin.

2) Withdrawals

In 1915, the State Engineer ordered the withdrawal of Ana River; Silver Lake and Paulina Marsh and all tributary streams; and the Warner Lakes and all tributary streams. In addition, the State Engineer withdrew 100,000 acre-feet of water from Deep Creek and tributaries for the Big Valley Reservoir. The purpose of the withdrawals was to withhold from further appropriation water required for projects under investigation by the U.S. Reclamation Service. In 1929, the Reclamation Service advised that there was little or no prospect of any projects being build in the Warner Lakes Valley for many years and released the related withdrawals.

In 1931, the Summer Lake Irrigation District paid the costs of the project investigations on the Ana River and was granted an allotment of 90 cfs for irrigation and power. The Ana River was reopened for further appropriation at that time. In 1935, the Silver Lake Irrigation District paid a portion of the costs of project investigations in the Silver Lake/Paulina Marsh area and was given an allotment of 19,460 acre-feet of water for storage in the East Thompson Valley Reservoir and the diversion dam reservoir and the rights to use 90 cfs for irrigation. However, the remaining water was not restored for general appropriation.

In 1965, the Water Resources Board withdrew from further appropriation the waters of Dutchy Lake, Church Lake and No Name Lake, and creeks feeding the lakes. The purpose of the withdrawal was to provide resting areas and breeding grounds for migratory and resident waterfowl. The withdrawal was amended in 1977 to permit limited use of water from the lakes and streams where such use is compatible with management programs for the waterfowl.

Table 10
Goose and Summer Lakes Basin Adjudications

Streams	Year	Irrigation Use				Stock/Domestic Use
		Duty per Acre	Maximum Volume	Rate per Acre	Irrigation Season	
Bridge Creek and tributaries	1971		3 AF/yr	1/80 cfs	Apr. 1 to Sept. 30	"a reasonable quantity... throughout the calendar year"
Buck Creek and tributaries	1926	3 AF	"Total... during any 30-day period shall not exceed 1 AF/acre"	1/40 cfs from Mar. 1 to June 15; 1/80 cfs from June 16 to Oct. 1	Mar. 1 to Oct. 1	Use of water for irrigation entitles use for stock and domestic. No extra allowed during irrigation season; 1 cfs/100 head of stock outside of irrigation season.
Chewaucan River and tributaries	1916	Rate and duty assigned user by user.				
Crane and Kelly Creeks and tributaries	1931	3/4 AF per 30-day period before June 1; 1/2 AF per 30-day period after June 1	Total shall not exceed 2-1/2 AF during the season	1/40 cfs	Mar. 15 to Sept. 15	Use of water for irrigation entitles use for stock and domestic. No extra allowed during irrigation season; 1 cfs/1,000 head of stock outside of irrigation season.
Drew, Thomas, Antelope, Cottonwood and Cogswell Creeks and tributaries (except lands served by Lakeview Water Users, Inc.)	1923	3/4 AF per 30-day period before June 1; 1/2 AF per 30-day period after June 1	Total shall not exceed 2-1/2 AF during the season	1/40 cfs	Apr. 1 to Sept. 30	Use of water for irrigation entitles use for stock and domestic. No extra allowed during irrigation season; 1 cfs/1,000 head of stock outside of irrigation season.
Lands served by Lakeview Water Users, Inc.	1961	Total quantity Lakeview Water Users may divert from its reservoirs and from Drews and Cottonwood Creeks shall not exceed 4.08 AF per acre of land irrigated.				
Silver Creek	1909	Rate and duty assigned user by user.				
Warner Lakes and tributaries	1928	3 AF		1/40 cfs before June 15; 1/80 cfs after June 15	Mar. 1 to Oct. 1	"not to exceed 0.1 cfs for each 1,000 head of stock."

Thomas Creek and tributaries were withdrawn from further appropriation by the Water Resources Commission in 1985. In ordering the withdrawal, the Commission concluded that the available streamflow in Thomas Creek was insufficient to meet current demands. The withdrawal does not include domestic use, livestock use, and water legally stored and released from storage.

The main ground water reservoir of the Fort Rock Basin was withdrawn in 1987. In ordering the withdrawal, the Commission concluded that the unrestricted issuance of additional ground water rights would allow expanded pumpage which could result in ground water overdraft. The withdrawal does not apply to several uses which typically require nominal quantities of water. The uses which are not subject to the withdrawal are stock watering, watering of lawns and gardens not exceeding three acres, applications which were pending as of the date of the withdrawal, quasi-municipal and single or group domestic purposes, and industrial or commercial purposes. The withdrawal will be in effect until 1990 and will be reviewed prior to that date by the Commission to determine if the period of withdrawal should be extended.

3) Minimum Streamflows

No minimum perennial streamflows have been established in the Goose and Summer Lakes Basin. Minimum streamflows have been considered at two previous times. In 1979, the Water Policy Review Board considered establishment of minimum streamflows on the Chewaucan River, Dairy Creek, Deep Creek, Honey Creek and Thomas Creek. At that time, the Board concluded that, given the absence of a basin program, adoption of minimum streamflows would require a more comprehensive evaluation of the water resources in the basin. The Board deferred further consideration of the minimum streamflows.

In 1983, the Department of Fish and Wildlife again requested establishment of minimum streamflows. The streams, and the flow levels which were recommended, are listed in Table 11. The Board rejected the proposed flows based on findings that the establishment of minimum flows was of lesser importance than agricultural use of the waters.

Table 11
1983 Minimum Perennial Streamflow Recommendations

Stream	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
Chewaucan River at USGS gage 10384000	40	40\50	50	50	50	50	75	75	50	30	30	30
Dairy Creek from the USFS bridge to Elder Creek	25	25	25	25	25	25	35	35	25	20	20	20
Honey Creek from USGS gage 10378500 to the lake	5	5	5	5	15	15	30	30	20	5	5	5
Deep Creek from USGS gage 10371500 to Adel	20	20	20	20	40	40	60	60	40	20	20	20
Thomas Creek from Cottonwood Creek to the lake	5	5	5	5	10	10	15	10/5	5	5	5	5

Source: Oregon Water Resources Department

3. STORAGE

a) Existing Reservoirs

A number of storage reservoirs have been constructed in the basin to provide water for irrigation, livestock and recreation. Most of the projects have been constructed by the irrigation districts. Table 12 is a list of the projects with capacities greater than 1,000 acre-feet.

Table 12
Existing Reservoirs

Subbasin/Name	Stream	Capacity (acre-feet)
Goose Lakes Subbasin		
Drews Reservoir	Drews Creek	62,500
Cottonwood Reservoir	Cottonwood Creek	8,740
Renner Dam	Dry Creek	3,270
Dog Lake Reservoir	Dog Creek	2,476
Muddy Creek Reservoir	Muddy Creek	1,363
Warner Lakes Subbasin		
Hart Lake Reservoir	Hart Lake tributaries	47,400
Greaser Lake Reservoir	Twentymile Creek	12,000
Priday Reservoir	Fish Creek	2,400
Mud Lake Detention Dam	Fish Creek tributary	1,813
Calderwood Reservoir	Fish Creek	1,477
Summer Lake Subbasin		
Thompson Valley Reservoir	Silver Creek	19,660

Source: Oregon Water Resources Department, 1988

b) Inventoried Sites

Several studies of potential storage projects have been conducted. While there is continuing interest in development of some of the projects, there are no active investigations or applications for development of the projects. Table 13 is a list of identified storage sites with potential capacities greater than 1,000 acre-feet.

Table 13
Potential Reservoir Sites

Subbasin/Site Name	Volume (Acre Feet)	Location Town	Range	Section
Goose Lake Subbasin				
Thomas Cr. (Old Mill)	3,015	38 S	18 E	12
Thomas Cr. (Campground)	2,368	38 S	18 E	1
Cox Flat	4,987	37 S	18 E	27
Bauer Creek	17,850	38 S	20 E	18
Cox Creek	9,492	38 S	20 E	5
Bullard Canyon	454	39 S	21 E	13
Deadman Canyon	440	39 S	21 E	14
Augur Creek	1,250	38 S	19 E	3
Thomas Creek				
Chewaucan Subbasin				
Coffeepot (Chewaucan)	115,000	35 S	18 E	4
Coffeepot Creek				
Bear Creek				

Source: Oregon Water Resources Department, 1988

SECTION 2
THOMAS CREEK

A. ISSUE

Lack of water for late-season irrigation, livestock, and fish habitat and passage in Thomas Creek.

B. BACKGROUND

1. PHYSICAL DESCRIPTION

The Thomas Creek drainage covers 325 square miles in the northwest portion of the Goose Lake Subbasin. Thomas Creek originates in the Coleman Rim area and flows for 40 miles east and south to Goose Lake. The upper portion flows through Fremont National Forest lands, entering the broad Goose Lake Valley at rivermile 19. From this point to its mouth, Thomas Creek flows through private agricultural lands.

Cottonwood and Cox Creeks are major tributaries to Thomas Creek. Cottonwood Creek drains 95 square miles and is roughly 30 miles long. It flows into a marsh near rivermile three on Thomas Creek. When the level of Goose Lake is elevated, Cottonwood Creek flows into the lake. Cox Creek drains about 70 square miles of the northern portion of the subbasin. It flows into Thomas Creek near rivermile 15.

Elevations in the drainage range from 4,700 feet at Goose Lake to nearly 8,000 feet at Cougar Peak. Annual precipitation varies from about 12 inches on the valley floor to over 22 inches in the mountains.

About one-third of the Thomas Creek drainage is managed by the U.S. Forest Service. The remainder is mostly privately-owned. About 70 percent of the drainage is used for timber and grazing purposes. Twenty percent is cropland, half of which is irrigated. The major irrigated crops are hay and small grains.

The Town of Lakeview lies within the drainage. With over 2,700 residents, the city accounts for approximately one-third of the Lake County population.

2. HYDROLOGY

Thomas Creek was gaged sporadically for a number of years (1912-17; 1928-31; 1946-58) at rivermile 19. A gaging station which was established at rivermile 30 in 1976 is still in operation. Thomas Creek has never been gaged in the Goose Lake Valley reach.

Thomas Creek flows are characterized by large seasonal and annual variability. Most runoff takes place March through May. Peak flows, however, occur during the winter months, most frequently in February. Because there are no reservoirs on Thomas Creek, flow is unregulated. Average annual flow for the drainage (including Cottonwood Creek) is estimated at 32,000 acre-feet (Water Resources Department, 1963). Thomas Creek approaches zero flow in late summer nearly every year. Flooding occurs annually on approximately 7,100 acres and causes damages of about $37,000 (WRD, 1976).

Cottonwood Creek has been gaged sporadically from 1908 to 1945 (1908-19; 1924-35; 1936; 1937; 1938-42; 1943; 1944; 1945), and continuously since 1946. Cottonwood Reservoir was built immediately upstream from the gage in 1923. The reservoir impounds 8,740 acre-feet for use by Lakeview Water Users, Inc. Another 240 acre-feet are impounded, but not regulated, by Cottonwood Meadows reservoir, built in 1961. Prior to the construction of Cottonwood Reservoir, nearly 70 percent of the annual runoff occurred from March through May. Six percent of the runoff took place July through September, with flows frequently dropping below 1 cfs. Peak flows occurred in April. Since construction, 70 percent of the runoff takes place April through June. At times, there is no flow during January, February, and March, as the reservoir fills, and again in August. Average annual flow for Cottonwood Creek is estimated at over 15,000 acre-feet.

Streamflow in the lower Thomas Creek drainage is greatly affected by agricultural development and use. Prior to agricultural development of the Goose Lake Subbasin, lower Thomas Creek probably had a braided channel and flowed through marsh lands. Conversion of those lands to agricultural uses has required extensive channelization of Thomas Creek. The confinement of flows to a single, straightened channel has resulted in hydraulic conditions which have caused down-cutting of up to 20 feet in several areas. Approximately 12,500 acre-feet of water is transferred via the North Drews Canal into the lower 17 miles of the Thomas Creek drainage. Thomas Creek flow is augmented by this source, as well as by flood irrigation return flows from other sources. Ground water contribution to streamflow in this area may also be very significant, especially as streams near Goose Lake, the ground water discharge area for the subbasin. Importation of Drews Reservoir water, return flows, and natural ground water discharge probably result in higher summer flows than seasonal precipitation patterns would suggest.

3. FISH RESOURCES

Thomas Creek supports native Goose Lake redband trout and eight species of nongame fish including the Pit sculpin. The native trout of the Goose Lake Subbasin comprise a unique race. The Pit sculpin occurs in the Pit River drainage, including the Goose Lake Subbasin, but is extremely rare in Oregon.

Goose Lake trout exhibit two life history patterns. The trout may reside permanently in tributary streams, or may live in the lake, spawning and rearing in tributary streams. Fair numbers of stream-resident trout are present in some tributaries to Goose Lake. However, the number of migratory trout is very low. Thomas Creek is the only Oregon tributary still supporting a substantial run of these fish. The last significant run occurred in 1978 when spawning adults from the lake were observed in most major tributaries. Sampling later that year revealed up to 2,700 trout fry per surface acre in Thomas Creek.

Migrating redband trout enter Thomas Creek from March to June. They must pass through the lower 20 miles of stream to reach the spawning areas on forestlands. Resident trout spawn during the same time. After spawning, the migrant trout return to Goose Lake.

Juvenile trout rear in the stream for one or more years before a portion of them migrate to the Lake.

4. WATER USE AND CONTROL

a) Water Use

Irrigation is the major water use in the drainage. Generally, pasture and hay crops are flood irrigated. Grain crops are sprinkler irrigated. There are rights to irrigate approximately 18,000 acres in the drainage. About one-quarter of these acres are irrigated with ground water. Over 12,000 acres are irrigated with decreed rights. That is, water already was being applied to most of the irrigated land by 1909.

Thomas Creek and its tributaries were adjudicated in 1923. The decree allows a continuous flow of one-fortieth of one cubic foot per second (cfs) per acre from April 1 to September 30, the irrigation season. Diversions are not to exceed three-fourths of one acre-foot per acre per thirty day period prior to June 1, and 1/2 acre-foot per acre per thirty day period from June 1 to September 30. In addition, total diversions during the irrigation season are not to exceed 2-1/2 acre-feet per acre.

Lands served by Lakeview Water Users, Inc. were adjudicated in a separate 1961 decree. Under this decree, the corporation may divert from its reservoirs and from Drews and Cottonwood Creeks a quantity not to exceed 3.9 acre-feet per acre. This quantity was based on a base duty of 2.5 acre-feet per acre, a 0.62 acre-foot per acre loss at the delivery point, and a 48 percent transmission loss.

Another important, though limited, water use is by the Town of Lakeview (7 cfs). The city uses ground water and some spring water to supply its water needs. Most industry in the drainage is served by city water.

Other uses include domestic, livestock, fish, fire protection, and recreation. These uses deal with only very small quantities of water.

Minimum perennial streamflows on Thomas Creek were considered by the Water Policy Review Board in 1979. Action on the flows was deferred. In 1983, adoption of minimum streamflows was again requested by the Department of Fish and Wildlife under Senate Bill 225. The Water Resources Commission rejected the proposed flows in 1985, but found that available streamflow in Thomas Creek was insufficient to meet demands. The Commission therefore withdrew the stream and its tributaries from further appropriation.

b) Water Control and Storage

The lower drainage is a complex network of canals, drainage ditches, and stream channels. Water is diverted from streams, marshes, and reservoirs. Water also is imported from Drews Reservoir, outside the drainage. Much of the lower Thomas Creek channel is diked to prevent spring flooding. Flooding problems are partly due to the extremely low gradient (0.1 percent) of Thomas Creek in Goose Lake Valley. Flooding may also be exacerbated by poor watershed and stream conditions.

There are three major reservoirs in the drainage:

Cottonwood Reservoir	8,740 acre-feet
Muddy Creek Reservoir	1,400 acre-feet
Cottonwood Meadows Reservoir	250 acre-feet

In addition, there are 23 reservoir permits with rights to store a total of less than 1,000 acre-feet in the drainage.

A reservoir study for a Thomas-Cottonwood Creek storage project was completed in 1976. The reservoir was proposed as a Public Law 566 watershed project to reduce flood damages, increase irrigation and municipal water supply, and improve fish and wildlife habitat. The project consisted of two reservoirs: one on Thomas Creek at Cox Flat and another on Cox Creek. The reservoir on Cox Creek would have been supplemented with Bauers Creek water delivered through a diversion canal. The two reservoirs would have held a total of nearly 12,000 acre-feet. It was estimated that the project would have provided water sufficient to supply 5,000 acres with a full supply of irrigation water. In addition, about 38,000 acres of land improvement were proposed under the project. Total cost was approximately $3 million. Although the project was recommended for authorization, it was never undertaken.

5. WATERSHED CONDITION

There have been no general inventories of watershed conditions in the lower Thomas Creek drainage. The Fremont National Forest has conducted a Soil and Water Improvement inventory for its lands, however. This inventory lists six areas in need of improvement. Some of the work has been performed on Thomas Creek and Warner Ski Hill. The areas in need of improvement are summarized below:

Project Name	Location	Acres	Trend	Rehab Cost
Tom Young Cr.	T38S,R18E,S15	5	Worsening	$2,000
Thomas Cr.	T37S,R17E,S25	200	Stable	50,000
Thomas Cr. Slumps	T37S,R17E,S25	10	Worsening	10,000
Shingle Mill Gullies	T38S,R19E,S9	0.2	Stable	2,000
Warner Ski Hill	T38S,R21E,S31	0.2	Worsening	4,000
Little Muddy	T39S,R18E,S2	0.4	Worsening	15,000

A map of General Erosion Sources in the 1978 SCS report, "Water and Related Land Resources, Goose Lake Drainage Subbasin, Oregon" shows severe streambank erosion on:

- The lower 3 miles of Mesman Creek, tributary to Cottonwood Creek
- Three miles of Cottonwood Creek immediately upstream from Cottonwood Reservoir.
- The shores of Cottonwood Reservoir.
- Rivermiles 22 to 38 on Thomas Creek.

A sedimentation map associated with the Department of Environmental Quality's non-point source assessment (DEQ, 1978) shows severe sedimentation problems on:

- Cottonwood Creek, from Cottonwood Reservoir to the mouth.
- Thomas Creek, rivermile 27 to the mouth.
- Bauers Creek

The 1978 SCS/WRD report also found that existing irrigation reservoirs in the Goose Lake Subbasin are a primary source of suspended sediment. Many reservoirs were constructed on

remnant geologic lake beds comprised of fine-textured soils. The reservoir sites were cleared and grubbed during reservoir construction and now contain steep unvegetated sections of shore line. Wind and wave action on the fine shoreline soils results in turbid water. The suspended sediments settle very slowly and can muddy streams and canals several miles downstream.

The Lakeview Soil and Water Conservation District funded a watershed study of the Cox-Bauers Creek drainage during the summer of 1987. The field examination report (Lasater, 1987) documented degraded stream conditions and management needs for the watershed. The study found that current stream channel conditions are below potential because of land use practices intended to increase crop, timber and livestock production. The resulting excessive stream channel erosion has affected the economic and natural resources of the area. A Coordinated Resource Management Plan is currently being written to meet stream channel improvement objectives of landowners.

In addition, the SCS is conducting a preliminary investigation of flooding and watershed problems in Bullard Canyon, which is at the eastern city limit of Lakeview.

C. ISSUE DISCUSSION

1. LACK OF WATER FOR IRRIGATION AND LIVESTOCK

In 1985 the Commission found that streamflows on Thomas Creek were insufficient to satisfy existing rights. If all 18,000 acres of water rights were exercised fully for the growth of hay and grasses, about 70 percent of Thomas Creek's annual flow would need to be applied during the irrigation season.

In certain reaches of Thomas Creek, the stream is entrenched. The water table has dropped ten or more feet in the immediate vicinity and thus affects water availability. Agricultural land use is disrupted by caving banks, loss of forage, and loss of fields to erosion. Landowners either bear the cost of bank armoring, check dams, or other extraordinary actions; or they bear the economic loss from decreased crop yields, reduction in herd size, or re-design and/or construction of water delivery systems.

2. LACK OF WATER FOR FISH HABITAT AND PASSAGE

Summer flows in the mainstem and tributaries of Thomas Creek above rivermile 20 are usually adequate for egg incubation and rearing of juvenile trout. In drought years, however, flows cease in some reaches. Headwater channels maintain surface flow, even in dry years. Low, warm, summer flows and degraded habitat caused by stream channelization limit trout production from rivermile 20 downstream to the mouth. In 1983, the Oregon Department of Fish and Wildlife developed minimum flow needs for Thomas Creek at the mouth. A WRD analysis indicated that the requested minimum flow of 5 cfs would not be met in August and September. The deficit appeared to be approximately 500 acre-feet.

Upstream passage of adult trout, and downstream passage of adults and juveniles to Goose Lake is a problem during low flow years when stopboards are placed in irrigation weirs before upstream and downstream movement is complete. In September 1987, the Citizens Advisory Committee and state agency personnel toured the lower 20 miles of Thomas Creek. There was agreement that irrigation weirs would not pose a problem, if properly maintained.

However, the inspection of the lowest diversion on Thomas Creek revealed fundamental design problems that could impede fish migration, as well as areas of riparian degradation.

The lower 20 miles of Thomas Creek are basically uninhabitable for resident trout. With little or no shade from riparian vegetation, lack of stream structure, turbid water, and low summer flows, the stream supports few trout. In recent years, trout numbers have dwindled. The trout season has been shortened, and the use by anglers has declined. Historically, Thomas Creek has supported far greater numbers of redband trout.

D. MANAGEMENT STRATEGY ALTERNATIVES

A variety of strategies may help solve or mitigate the water resources problems in and along Thomas Creek. Some of these strategies can be implemented through Commission action. These strategies generally only affect new water rights. By law, the Commission cannot modify, set aside or alter existing water rights. Most other strategies will require action by other agencies and commissions. The strategies are not mutually exclusive. That is, implementation of more than one of the identified strategies may be appropriate.

1. WATER RESOURCES COMMISSION ACTIONS

a) Withdrawal from Appropriation

One possible Commission action to protect present flow levels would be to continue or expand the withdrawal of the Thomas Creek drainage. This would help to keep conflict from increasing by protecting current users from incidental encroachment by new water users. The current withdrawal does not include domestic and livestock uses and the use of water legally stored and released from storage. As a result, small reductions in streamflow levels may occur with continued appropriation for these uses. State water law requires that preference be given to domestic and livestock uses. Expansion of the withdrawal to include the preferred uses would provide increased protection for remaining flows. However, domestic and livestock uses generally do not require significant quantities of water and the potential for major new appropriations is limited. Ground water, which is not affected by the withdrawal, provides an alternative source of water in most areas of the drainage.

The potential exists for ground water use to contribute to continued reductions in Thomas Creek flows. In the valley, the water table is generally below the streambed of Thomas Creek. Where this is the case, pumping from a nearby well will increase the rate of movement of water from the stream to the shallow ground water aquifer. A prohibition on new well construction for all uses for which the surface water has been withdrawn would protect Thomas Creek flows. In the areas of the drainage on the valley floor with alluvial and fluvial terrace and lacustrine deposits, new wells for uses not exempted by the surface water withdrawal could be required to be at least 1,000 feet from perennial streams or take water from a confined aquifer. A well taking water from a confined aquifer generally would have a depth of 100 feet or more. In addition, restrictions on ground water use from alluvial deposits in upland areas also would be needed to assure that Thomas Creek flows are not reduced further.

b) Water Reservations

A reservation of water would hold a quantity of water for specified future uses. A right for use of the reserved quantity of water would have as a priority date that on which the Commission acted on the reservation. For example, the Commission could reserve 12,000

acre-feet (or some other quantity) of water for storage and subsequent use in the Thomas-Cottonwood project. If the project were built, use of the water under the project would have, for example, a 1987 priority date. This could give users of that water seniority over rights secured after adoption of the reservation. No new rights for significant quantities of water are expected if the present withdrawal is retained.

c) Conditions on New Permits

Permit conditions offer another method of protecting current water users and assuring the highest and best use of the water resource. Currently, "waters legally stored and released from storage" are exempt from the Thomas Creek withdrawal. Placing restrictions on future water rights that store or use stored water would help to maximize the benefits from use of the limited water supply. For example, a stipulation could be included in future permits requiring the new use of Thomas Creek water to be based on maximum conservation (e.g., use of sprinklers or minimum transmission loss). Another possible condition for new storage projects could be specification of a minimum pool elevation to provide for recreational uses of the reservoir. In addition, new storage permits could be conditioned to require passage of a quantity of streamflow during periods of reservoir filling.

d) Minimum Streamflows

Adoption of minimum perennial streamflows would protect existing flows to the extent that the flows are needed for fish life, pollution abatement or recreation. A minimum streamflow is administered like a water right for instream uses. That is, regulation for a minimum streamflow is based on the priority date of the streamflow in relation to other water rights on the stream. Use of senior rights is not affected by adoption of and regulation for the minimum streamflow. Only water rights with priority dates junior to that of the minimum streamflow will be regulated as needed to meet the specified flow level. In addition, adoption of a minimum streamflow would not affect the storage and release of water under existing rights. A minimum flow, however, differs from a water right in that it is an administrative action and can be changed by the Commission.

Minimum flows are also similar to reservations. The quantity of water requested need not be available at the time of the request. Some minimum flow levels, in effect, reserve future volumes of water that might become available through watershed improvements or other water supply augmentation.

If the Commission adopted a minimum streamflow, the priority date would be 1988 or later. In previously rejecting the request by ODFW, the Commission concluded that irrigation use is a more important use of water. Domestic and livestock uses and use of stored water generally have been exempted from regulation for adopted minimum streamflow requirements. Therefore, adoption of the flows would not provide additional protection over that offered by the present withdrawal of Thomas Creek. However, adoption of the flows would establish objectives for improvement of the late summer and fall flows and would require passage of adequate flows to support fish life by any new storage facilities.

2. ACTION BY OTHER AGENCIES AND ORGANIZATIONS

The drainage area is fortunate in having a well-developed network of agricultural land management organizations such as the Lakeview Soil and Water Conservation District, the Lakeview-Thomas Creek Water Control District, the SCS, the ASCS, and others. The participation by these organizations, as well as by state agencies and the private landowners, in a program for coordinated resource management would permit improvement of water

resource conditions to the benefit of all users. The following actions could be elements of such a coordinated resource management program:

a) Restoration of Riparian Areas

Rehabilitation of Thomas Creek riparian areas would improve water resources in the drainage. Thomas Creek is vital to both agricultural and fisheries uses. Its proximity to Lakeview and major transportation corridors also increases its recreational and, therefore, economic potential. Restoring riparian areas along the entire length of Thomas Creek would benefit all these uses.

Riparian area and watershed rehabilitation planned and in progress on the Fremont National Forest promises to increase the water-holding capacity of the drainage. Decreasing flood flows and increasing late summer flows has obvious benefits downstream to: landowners, irrigators and fish. In addition, with more shade and less erosion, the quality of the water is improved. This benefits the redband trout, particularly by improving spawning habitat.

Treatment of all sites within the drainage which have been identified as degraded and which are listed in the Fremont National Forest Soil and Water Improvement Inventory would contribute to improvement of the water resource. In addition, special provisions for protection of riparian areas from the potential effects of timber harvest and grazing would provide additional benefits. Available techniques include retention of buffer strips, more intensive grazing management and development of exclosures.

There also is a great need for riparian rehabilitation on the private lands along Thomas Creek in Goose Lake Valley. The elimination of willows from most areas along Thomas Creek has resulted in a loss of shading needed to maintain lower water temperatures and of root structure needed to stabilize soils. The use of riparian areas for cattle grazing is not incompatible with maintenance of healthy vegetative stands. However, increased management is needed to ensure that the cattle are moved when the forage has been consumed. Increased management and better use of forage would be facilitated by development of riparian pastures. In addition, restoration of many areas along Thomas Creek may require an extended period of rest from any use.

b) Stabilization and Restoration of Channel Structure

Thomas Creek is deeply entrenched in many reaches. The lakebed sediments which make up the Goose Lake Valley floor are highly susceptible to erosion. Regrowth of willows and other vegetation along the stream would help to stabilize the channel. In many areas, significant recovery of the stream channel can be expected with regrowth of vegetation. However, in many areas other measures likely will be needed to bring the channel back up to historic levels. Loose-rock checkdams would stabilize the channel and would catch sediments needed to rebuild the channel.

c) Provision for Fish Passage

There are two possible approaches to assuring fish passage over diversion structures on Thomas Creek. The first is a voluntary approach. Landowners or diversion operators could be contacted each fall and reminded of the importance of removing stopboards. Success of this approach is dependent upon the cooperation of landowners and the diligence of those who make contact. Either of these may vary from year to year and the failure of only one landowner to remove the stopboards could totally block the migration of redband trout to spawning areas.

Where the voluntary approach fails, the Fish and Wildlife Commission has statutory authority to order installation of passage facilities at any existing or planned facility which blocks the movement of game fish. The owner may protest this order to the Water Resources Commission. The WRC then holds a hearing to determine if development of the passage facilities is in the public interest. The WRC may approve, disapprove or modify the facilities ordered by the Fish and Wildlife Commission. If the owner is required to make a change and fails to, the structure or any of its parts may be removed.

d) Development of Storage

The Thomas-Cottonwood Creek project offers a method for improving the availability of water for all uses during the late summer and fall. A review of the project, especially in conjunction with any coordinated resource planning associated with Thomas Creek, might reveal methods to increase public benefits and thus the likelihood of funding. However, such a reconsideration would be expensive and would still face the rather intractable problems of decreased federal funding for storage projects, poor water quality inherent in local reservoirs and the possible disruption of fish migration.

SECTION 3
DEEP AND CAMAS CREEKS

A. ISSUE

Lack of water for late-season irrigation, livestock, and fish habitat and passage in Deep and Camas Creeks.

B. BACKGROUND

1. PHYSICAL DESCRIPTION

The Deep Creek drainage encompasses about 275 square miles in the southwest portion of the Warner Lakes Subbasin. Deep Creek rises on the east slope of the Warner Mountains and flows generally north and east over 30 miles to its confluence with Crump Lake. Major tributaries include Camas and Drake Creeks which flow into Deep Creek at rivermiles 15 and 13, respectively. Deep Creek drops over a sizeable falls at rivermile 10 before entering the Warner Valley near Adel, about rivermile 8.

Elevations in the drainage range from 4,475 feet above sea level at Crump Lake to over 8,400 feet on Crane Mountain. Adel receives approximately eight inches of precipitation annually. In the mountainous portions of the drainage, precipitation may approach 20 inches.

Lands in the eastern third of the drainage, including the lower reaches of Deep, Camas and Drake Creeks, are managed by the BLM. Roughly 100 square miles in the upper reaches of Deep Creek and the southern portion of upper Camas Creek are administered by the Fremont National Forest. There are major concentrations of private land in Big Valley on upper Deep Creek, in the northern portion of the Camas Creek drainage, and in Warner Valley. Most of the land in the Deep Creek drainage is managed for timber and range. Irrigated agriculture is limited largely to Big and Warner Valleys. The unincorporated settlement of Adel lies within the drainage.

2. HYDROLOGY

The Deep Creek drainage has been gaged at three locations. Drake Creek was gaged for approximately 23 years one mile upstream from the mouth. Camas Creek was gaged for over 25 years about seven miles from its mouth. Deep Creek has been continuously gaged five miles west of Adel since October 1929.

Deep Creek's average annual discharge, as measured at the gage, is approximately 94,000 acre-feet. The records of the two other gages suggest that Camas and Drake Creeks

contribute 36 and 11 percent, respectively, of Deep Creek's annual flow. Although Drake Creek has a low annual discharge, spring-fed flows hold up well throughout the summer. More than 66 percent of the average annual runoff occurs March through May. The maximum discharge on Deep Creek is estimated at 3,190 cfs. The minimum recorded flow was 0.9 cfs in August 1960.

3. FISH RESOURCES

The Deep Creek drainage above Drake Creek supports native redband trout and hatchery rainbow trout. ODFW believes that Deep Creek, in its Warner Valley reach, provides suitable habitat for Warner sucker. The BLM concurs. The agency also notes that if a population of sucker could be established above the falls, it would help secure survival of the species. The U.S. Fish and Wildlife Service notes that sucker were collected from Warner Creek, a tributary of Deep Creek, in 1908. No sucker have been collected recently, however. Brook trout inhabit some of the headwaters of the drainage. Redband trout are abundant in the headwaters and in some lower reaches where cover, flows and summer temperatures are suitable. Growth is good, with fish reaching 7 inches in their first year, and 11 inches in the second year. Deep Creek is stocked with 6,000 catchable-size rainbow trout annually.

The native redband trout migrate upstream to spawning areas March through June. Spawning gravel is limited in the lower reaches of the stream. Deep Creek falls blocks upstream movement of the trout that inhabit the lower creek. The BLM, in its 1986 Warner Lakes Resource Area Aquatic Management Plan, reports that when Crump Reservoir washed out, a plug of rock and mud was deposited in Drake Creek blocking redband trout migration. The plug also has isolated a population of fish upstream. Juvenile and adult trout rear throughout the Deep Creek stream system during the entire year.

Deep Creek supports a popular trout fishery. Access to the lower 9 miles of stream from highway 140 is excellent. Forest Service and BLM roads provide good access to upstream areas. Several unimproved campsites border the lower stream reach and two Forest Service campgrounds are located in the upper drainage. Generally, angler success is good.

4. WATER USE AND CONTROL

a) Water Use

Irrigation is the major water use in the drainage where there are rights to irrigate over 13,000 acres. There are four ground water rights in the drainage that irrigate about 800 acres. This ground water is for supplemental use. Major irrigated areas include Big and Warner Valleys.

Other uses in the Deep Creek drainage include domestic, livestock, recreation and wildlife. These uses have rights to quite limited quantities of water.

b) Water Control and Storage

There is little regulation of flow in the drainage. Two reservoirs on Drake Creek, including Crump Reservoir which washed out, impounded 436 acre-feet.

5. WATERSHED CONDITION

The Fremont National Forest and the Lakeview District of the BLM have conducted watershed inventories of lands under federal control.

The Fremont National Forest identified five sites in the drainage in need of rehabilitation:

Project Name	Location	Acres	Trend	Rehab Cost
Horse Creek Gully	T39S,R21E,S24	3.0	Worsening	$9,000
Camas Creek #1	T39S,R21E,S1	1.5	Worsening	12,000
Camas Creek #2	T39S,R22E,S5	7.0	Worsening	24,000
Burnt Creek Rip.	T40S,R21E,S1	0.4	Stable	2,500
Willow Creek #2	T40S,R21E,S13	1.0	Stable	5,000

The BLM has conducted extensive inventories of Deep Creek recently. The drainage has had little or no stream improvement work and has more habitat in poor condition than any other stream system in the Warner Lakes Subbasin.

Stream Condition (in miles)					
Stream	Excellent	Good	Fair	Poor	Unknown
Camas Creek	0	0.8	0.8	2.0	0
Deep Creek	0	3.0	2.5	4.1	0.1

The BLM intends to improve the conditions shown above by one class within 10 years. Accordingly, much work is proposed for Deep Creek.

In the Sage Hen Butte area, Deep Creek is in poor condition from bank cutting and vegetation removal. To aid in vegetation recovery, an exclosure of 110 acres is planned. Juniper cabling along over one-half mile of stream is needed to slow bank cutting. From the point where Deep Creek enters the canyon, about rivermile 18, to the confluence with Camas Creek, bank damage is occurring. Juniper cabling will improve bank stability and a fence will protect 700 acres of canyon, including 3.7 miles of stream.

On Drake Creek, the BLM is exploring ways to remove the mud and rock plug deposited when Crump Reservoir washed out. In addition, fences are planned to remove livestock from the canyon. The fences will exclude 217 acres and protect 2.1 miles of stream. The area where the Roaring Springs Fork of Drake Creek enters BLM land also will be fenced. The fence will exclude 65 acres of mostly wet meadow and protect one-half mile of stream.

In the Camas Creek drainage, more than a mile of bank damage has occurred along Parsnip Creek near Highway 140. A fabric irrigation dam on adjacent private land has stopped active head cutting and has raised the water table two to three feet. Juniper cabling and check dams are expected to have the same results. A pasture division fence in the Sage Hen Allotment is planned to control grazing on two miles of Camas Creek and 345 acres of riparian and upland habitat. In addition, a quarter mile of juniper cabling is planned to rehabilitate eroded stream banks on Camas Creek.

Where possible, livestock management is preferred over exclusion. Exclusion is used primarily where livestock management is not possible, as in rocky, steep-sided canyons and in areas of 100 acres or less. A half mile of Drake Creek canyon was excluded from

livestock in 1987. A fence near Finucane Spring would protect 55 acres and 0.4 mile of Fish Creek. A summary of needed actions follows:

Stream	Fencing	Juniper Cabling	Boulder Placement	Log Sills	Rock Deflectors
Deep Creek	9.25 mi	2.0 mi	1.5 mi	0.5 mi	0.5 mi

Exclosures			
Stream	Acres	Miles of Stream	Miles of Fence
Deep Creek	1,277	7.8	7.25

Cost Estimates		
Fences on:		
Deep Creek	2.7 miles	$ 4,100
Camas Creek	2.0 miles	3,000
Drake Creek	3.0 miles	4,500
Finucane Spring	1.5 miles	2,250
Bank Stabilization on:		
Camas Creek (juniper)	0.25 mile	$1,800
Deep Creek (juniper)	0.75 mile	4,400
Parsnip Creek (juniper)	1.00 mile	4,000
Pool/Gravel Development on:		
Deep Creek (boulders)	1.5 miles	$6,600
Deep Creek (deflectors)	0.5 mile	2,200
Drake Creek (log sill)	0.5 mile	2,500
Fish Passage on:		
Drake Creek		$ 3,500
Total Cost		$38,850

The need for watershed and riparian area rehabilitation on private lands in the Deep Creek drainage probably is similar to that needed on federal lands. The BLM reported that Deep Creek was in poor condition between the public land in Big Valley and where it enters the canyon. This 3.5 mile stretch is in private ownership. The BLM also indicated that the land would benefit from improved livestock management and streambank rehabilitation. The possibility of a land exchange is under investigation.

C. ISSUE DISCUSSION

1. LACK OF WATER FOR IRRIGATION AND LIVESTOCK

There are at least two indications of lack of water supply for agricultural uses in the drainage. If all 68,000 acres with water rights were exercised to the full extent of the duty allowed (3 acre-feet per acre per season), about 204,000 acre-feet would be required. This is over twice the average annual discharge of the drainage. Secondly, the recent development of ground water resources, mainly for supplemental use, is indicative of water need.

Many of the major tributaries in the drainage are degraded. Many of them have sloughing banks and are entrenched. In areas such as Camas Prairie and Big Valley, deteriorating

stream conditions probably have affected beneficial use of adjacent private and public lands. Dropping water tables and caving banks disrupt agriculture by reducing forage and water availability.

2. LACK OF WATER FOR FISH HABITAT AND PASSAGE

Spring and summer flows are presently adequate for adult trout migration, spawning and egg incubation. Flows are adequate for both adult and juvenile redband and hatchery trout in normal years. In drought years, however, low flows in late summer can limit trout production by severely limiting rearing space. Low flows also intensify other habitat problems such as lack of cover, high water temperatures and poor water quality.

Fish passage is affected mainly by instream barriers. One is Deep Creek falls. Although this falls is natural, there may be opportunities to overcome the difficulties it presents through transplantation of fish stocks. The second barrier is the Drake Creek plug. Removal of the plug would restore spawning habitat now unavailable to redband trout.

The U.S. Fish and Wildlife Service believes that the Warner sucker has been eradicated from the Deep Creek drainage. The Service has attributed such eradication, at least in part, to water diversions used to promote farming activities. It points out that "such water barriers and diversions are particularly detrimental to this ... species." There are several major diversions in the Warner Valley reach of Deep Creek. Their specific impact on the species is not known, though improper maintenance and operation might impede migration. ODFW and BLM, however, maintain there is no evidence to suggest the Warner sucker is not present. These agencies believe that because the sucker is present in similar nearby streams (Honey and Twentymile Creeks), and because the drainage has historically supported the Warner sucker, they are probably still present.

The lower eight miles of Deep Creek are basically uninhabitable for resident trout. With little riparian vegetation for shade and little or no channel structure, the stream supports few, if any, trout in this reach.

D. MANAGEMENT STRATEGY ALTERNATIVES

A variety of strategies may help solve or mitigate the water resources problems in and along Deep and Camas Creeks. Some of these strategies can be implemented through Commission action. These strategies generally only affect new water rights. By law, the Commission cannot modify, set aside or alter existing water rights. Most other strategies will require action by other agencies and commissions. The strategies are not mutually exclusive. That is, implementation of more than one of the identified strategies may be appropriate.

1. WATER RESOURCES COMMISSION ACTIONS

a) Withdrawal from Appropriation

With twice the amount of water allocated than the drainage normally produces, the drainage appears to be fully appropriated. A withdrawal order would recognize this condition, and offer some protection to existing users from incidental encroachment by new users. A withdrawal order could be crafted to exempt uses that might be essential or still possible in the drainage. These exemptions might include, for example, domestic and livestock uses or non-consumptive uses such as fish life, pollution abatement or recreation. Another possible

exemption might be for waters stored or released from storage. Should the drainage be withdrawn from further surface water appropriation, ground water may provide alternative sources.

b) Classifications and Conditions on New Permits

Another available strategy is to restrict the use of the drainage's waters to specific uses. The drainage might be classified, for instance, for the essential or non-consumptive water uses listed above. Permit conditions offer another method for protecting current water users. Placing restrictions on new uses of water could help assure the best use of local water resources in several ways. For example, new irrigation rights might be based on maximum conservation of water. New or relocated diversion structures might be required to have fish screens or applicants might be required to show that diversion structures will not impede fish migration.

c) Minimum Streamflows

A minimum streamflow, if adopted, would have a priority date of 1988 or later. It could affect only rights obtained after that date and that are upstream from the gage. Presently, about 7,300 acres are irrigated upstream from the gage. This represents about 11 percent of the total irrigated acreage in the drainage. Opportunities for additional irrigation development in the upper drainage are limited. Domestic and livestock uses have generally been exempted from regulation for adopted minimum flow requirements. It is unlikely that a minimum flow would be satisfied under current conditions. However, it could establish targets that might be met as a result of on-going watershed enhancements in the drainage.

2. ACTIONS BY OTHER AGENCIES AND ORGANIZATIONS

A major portion of the drainage is federally-managed. The U.S. Forest Service and the BLM have identified watershed enhancement needs on their lands. The U.S. Fish and Wildlife Service has a major presence in protecting the threatened Warner sucker. Actions by these agencies coupled with programs of state and local interests can improve water resource conditions to the benefit of all users.

a) Restoration of Riparian Areas

Riparian and watershed rehabilitation planned and in progress on the Fremont National Forest promise to increase the water-holding capacity of the upper Deep Creek drainage. The BLM's proposed Deep Creek rehabilitation plans hold similar promise for the middle and lower drainage. Increasing late summer flows, raising water tables and decreasing flood flows have obvious benefits downstream for landowners, irrigators and fish life.

Treatment of all sites that have been identified by the two major federal entities in the drainage would contribute significantly to the improvement of local water resources. In addition, specific provision for the protection of riparian areas from potential damage from timber harvest and grazing would provide additional benefits. Approaches to such protection include retention of buffer strips, more intensive grazing management, establishment of exclosures and development of alternative stock watering facilities.

A program of riparian restoration on private lands is an important element in the recovery of water resources in the Deep Creek drainage. The state, through its Departments of Fish and Wildlife and Agriculture, and the Oregon State University Extension Service, has many

resources to aid private landowners in rehabilitating stream side lands. Local involvement through the Lakeview Soil and Water Conservation District also offers landowners an avenue for such rehabilitation.

b) Stabilization and Restoration of Channel Structure

Deep, Camas and Drake Creeks are entrenched and/or have sloughing banks in many reaches. Lakebed sediments in the Warner Valley reach are highly susceptible to erosion. Revegetation of the stream along its entire length, and especially in this reach, would help stabilize the channel. There are other reaches, such as those identified by the BLM, where additional measures will be required for bank stabilization. Check dams and juniper cabling are two measures that would stabilize and rebuild banks. The use of log sills and rock deflectors will aid restoration of channel structure. Again, involvement of the federal government, state agencies and local experts will be required to take full advantage of the opportunities for streambank stabilization.

c) Provision for Fish Passage

Removal of the Drake Creek plug contemplated by the BLM would offer an immediate solution to one fish passage problem. The cost of removing the plug is minimal and removal would have a significant beneficial effect on the fishery. As an alternative, transplantation of fish stocks, either redband trout or Warner sucker, above Deep Creek falls would mitigate for the problem. Such a transplantation would require the cooperation of the BLM, ODFW and the USFWS.

Resolution of potential passage problems caused by irrigation diversion dams will require a more specific identification of which diversions, if any, are impeding migration of Warner sucker. Such identification would best be made by ODFW and the USFWS. In the event structures are shown to be causing problems, remedial action might include identification of funds for re-design of structures or coordination and cooperation between the agricultural community and fisheries interests in operation of existing structures. These actions would most likely involve the BLM, USFWS, ODFW, the Warner Valley Stockgrowers Association and the Lakeview Soil and Water Conservation District.

SECTION 4
HONEY AND SNYDER CREEKS

A. ISSUE

Lack of water for late-season irrigation, livestock, and fish habitat and passage in Honey and Snyder Creeks.

B. BACKGROUND

1. PHYSICAL DESCRIPTION

The Honey Creek drainage covers about 230 square miles in the northwest portion of the Warner Lakes Subbasin. Honey Creek is about 25 miles long and flows east through a canyon in North Warner Rim and onto the Warner Valley floor before entering Hart Lake. The drainage is bounded on the south by an east-west trending belt of mountains; on the west by Abert Rim; on the north by the Coyote Hills; and on the east by Hart Lake. Major tributaries are Twelvemile, McDowell, and Snyder Creeks.

Elevations in the drainage range from 4,473 feet above sea level at Hart Lake to 8,407 feet at Drake Peak. Precipitation averages about eight inches annually on the valley floor and approaches 30 inches in the mountains.

The BLM manages about 40 percent of the drainage. About 37 percent is held privately. These ownerships are intermixed throughout the drainage. The Forest Service controls about 16 percent of the basin, mostly in headwaters on the east side of Abert Rim. Most of land is devoted to timber and range uses. Irrigated agriculture occurs along the major tributaries and in the Warner Valley. The unincorporated community of Plush is within the drainage.

2. HYDROLOGY

Honey Creek has been gaged near Plush continuously since 1930. The average annual flow is 21,740 acre-feet. The maximum discharge was estimated at 11,000 cfs in December 1964. Almost 80 percent of run-off occurs March through June. August and September are the months with the lowest flows. At times there is no flow. Once Honey Creek enters the valley, water is diverted through a number of irrigation and drainage channels. Normally most of the flow is diverted from the main channel before it can reach Hart Lake.

3. FISH RESOURCES

Honey Creek supports native redband trout, brook trout, Warner sucker, and two other nongame fish species. Redband and brook trout populations are healthy above rivermile 16. Redband trout below that point vary with habitat conditions. For example, no trout were found near rivermile 10 in September 1981, after a very dry summer. However, a year later the same area supported a good population. This illustrates the ability of the native trout to recover as conditions improve. Brook trout generally do not occur below rivermile 16. Redband trout may grow to eight inches in their first year. Redband trout that rear in Hart Lake can reach 20 inches in four years.

Redband trout in Honey Creek have two life history patterns. Some fish live entirely in the stream, while others migrate to Hart Lake as juveniles and grow to maturity in the lake before returning to spawn in the stream. Trout from the lake enter the stream from March through early June, spawn, then return to the lake. Trout that reside in the stream move to spawning areas during the same period. Fry emerge from May through July and rear in the stream before a portion of them drop downstream to the lake.

Warner sucker are limited to the lower 14 miles of stream. The sucker population is very small. Only 65 Warner sucker were collected during three years of study (1978-80). Warner sucker live both in the stream and in Hart Lake. They spawn in Honey Creek in April and May. At times the migration may be as late as June. The U.S. Fish and Wildlife Service has designated as critical habitat Honey Creek from the mouth to about rivermile 16 and Snyder Creek from the mouth to roughly rivermile three. This designation applies to lands 50 feet on either side of the streams.

Forest Service roads provide good public access to the upper drainage. Several unimproved camping areas are located in the headwaters. Upper Honey Creek supports a popular trout fishery and provides good angling. The lower creek receives light use and produces large trout at times.

4. WATER USE AND CONTROL

a) Water Use

Water rights were adjudicated for Warner Lakes and tributaries in 1928. Irrigation is the major water use in the drainage. About 7,000 acres are irrigated in the drainage. Only 1,000 acres are irrigated with ground water. About three-quarters of this figure is for supplemental application of water. About half of all the acres irrigated have been applied for since 1950. No domestic or other significant uses exist in the drainage.

b) Water Control and Storage

Seven small storage reservoirs have a combined capacity of about 1,600 acre-feet. The Water Resources Department made a preliminary study of a reservoir site on Snyder Creek. While the project appeared feasible, no agreement was reached with landowners to warrant proceeding with the investigation. In addition, a scattering of stock and wildlife watering ponds exist in the drainage.

5. WATERSHED CONDITION

The Fremont National Forest has identified no sites needing rehabilitation in this drainage. The BLM has identified a need for further inventory of 26 stream miles in the Honey Creek drainage. Little work is planned in the area because of access problems and the pattern of land ownership. A fence is planned to exclude stock from the canyon north of Deppy Creek. A stream survey found no good spawning gravel in Twelvemile Creek. The only place where access allows work is at Twelvemile Crossing. Boulder placement at this point will add 150 square yards of good spawning gravel. Juniper cabling in the same location will improve bank stability. A summary of information available from the BLM follows.

Stream Condition (in miles)					
Stream	Excellent	Good	Fair	Poor	Unknown
Honey Creek	0	1.9	0.5	0.9	0
Snyder Creek	0	0.4	0.5	0.6	0
Twelvemile Creek	0	0.7	0	0.1	1.3

Project Summary

Stream	Fencing	Juniper Cabling	Boulder Placement	Land Acquisition
Honey Creek	0.25 mi	0.50 mi	0.5 mi	280 acres

Cost Estimates		
Fences on Honey Creek	0.25 miles	$375

According to ODFW, the BLM has constructed fences to protect 8.3 miles of Honey Creek and 4.5 miles of its tributaries from improper grazing. The Fremont National Forest plans to improve 3 miles of streambank on a tributary of Honey Creek by fencing and revegetation. In 1980, ODFW removed a large debris jam from the lower creek to improve upstream fish passage.

C. ISSUE DISCUSSION

1. LACK OF WATER FOR IRRIGATION AND LIVESTOCK

If all acreage in the drainage irrigated under permits for primary use were exercised to the full duty of water allowed, about 73,800 acre-feet of water would be required. This is approximately three times the average annual yield of the drainage. Some ground water was being used in the drainage as early as 1949. Most of the ground water permits are for supplemental use. These conditions illustrate the relative scarcity of water relative to demand.

2. LACK OF WATER FOR FISH HABITAT AND PASSAGE

Spring runoff in normal water years is adequate for upstream passage and spawning of adult trout and sucker from Hart Lake. Upstream fish passage is limited or blocked in years of low spring runoff when most water is diverted from the lower 3.5 miles of stream for irrigation

beginning in March. This also interferes with adult fish moving downstream to the lake after spawning and with juvenile trout and sucker migrating downstream to the lake to rear.

Adequate flows for egg incubation and rearing occur above river mile 16.8 (where the last major diversion is located) the entire year. Flows between the gage (rivermile 3.8) and rivermile 16.8 are adequate for spawning, egg incubation, and support of adult and juvenile trout and sucker through June in normal water years, and all year in good water years. Low flows in this section limit rearing habitat from July through October in normal years and can eliminate trout during drought years. Warner sucker usually survive in pools even when the creek becomes intermittent. Low flows also intensify the impacts of other fish habitat problems, including lack of cover, shade, and high water temperatures. Both redband trout and Warner sucker have adapted to survive the severe habitat conditions that can occur in Honey Creek.

D. MANAGEMENT STRATEGY ALTERNATIVES

A variety of strategies may help solve or mitigate the water resources problems in and along Honey and Snyder Creeks. Some of these strategies can be implemented through Commission action. These strategies generally only affect new water rights. By law, the Commission cannot modify, set aside or alter existing water rights. Most other strategies will require action by other agencies and commissions. The strategies are not mutually exclusive. That is, implementation of more than one of the identified strategies may be appropriate.

1. WATER RESOURCES COMMISSION ACTIONS

a) Withdrawal from Appropriation

Honey Creek appears to be fully appropriated. A withdrawal order would acknowledge the present balance of supply versus demand. It would provide a measure of protection for existing users against inadvertent encroachment by additional users. The order could exempt uses still possible in the drainage, such as domestic and livestock uses, or non-consumptive uses such as fish life and pollution abatement.

b) Water Reservations

A reservation of water for storage purposes might provide some incentive for future development of projects studied but never built.

c) Classifications and Conditions on New Permits

The drainage could be classified specifically and exclusively for uses which are either essential to the drainage (domestic, livestock, or fire protection) or could be accommodated by the limited water supply (such as non-consumptive uses like pollution abatement, fish life or recreation). Conditions or restrictions might be placed on future permits that would require, for example, maximum conservation in the use of water for any purpose. Or conditions might be placed on any new diversion structure that would require fish screens or the removal of stopboards after a certain date.

d) Minimum Streamflows

If the Commission were to adopt a minimum streamflow, it would have a priority date of 1988 or later. It could affect only rights applied for after that date for water use upstream from the gage. Opportunities for additional irrigation upstream from the gage appear limited. Although it is unlikely under current conditions that minimum flows would be met from August through October, the flows would establish objectives for improvement of late-season yield.

2. ACTIONS BY OTHER AGENCIES AND ORGANIZATIONS

The ownership pattern in the drainage is mixed which both complicates and mandates a coordinated program for the improvement of the local water resources. The U.S. Forest Service and the BLM are fundamental to any improvement in the drainage. The U.S. Fish and Wildlife Service may also play an important role in identifying passage and habitat problems, as well as funding opportunities for rectifying the problems. ODFW and the local agricultural community as represented by the Warner Valley Stockgrowers Association and the Lakeview Soil and Water Conservation District can make significant inroads into addressing water problems on private lands in the drainage.

SECTION 5
TWENTYMILE CREEK

A. ISSUE

Lack of water for late-season irrigation,livestock, and fish habitat and passage in Twentymile Creek.

B. BACKGROUND

1. PHYSICAL DESCRIPTION

The Twentymile Creek drainage covers about 240 square miles in the southern portion of the Warner Lakes Subbasin. The southern half of the drainage is outside the state—approximately one quarter in California and one quarter in Nevada. Twentymile Creek is roughly forty miles long. The creek heads on forestlands on the east face of the Warner Mountains. The stream enters Warner Valley at rivermile 20. It empties into Crump Lake about six miles northeast of the community of Adel.

The major tributaries to Twentymile Creek are Twelvemile Creek which enters at rivermile 23, and Fifteenmile Creek, tributary to Twelvemile Creek. Lands in the upper drainage are managed largely by the Bureau of Land Management for grazing purposes. The U.S. Forest Service administers about 20 square miles of the drainage in the Warner Mountains. Lands in the Warner Valley are mostly privately- owned and devoted to both dryland and irrigated agriculture.

Elevations in the drainage range from 4,475 feet above sea level at Crump Lake to 8,290 feet at Mt. Bidwell, California. Annual precipitation ranges from roughly 8 inches in Warner Valley (at Adel) to over 30 inches in the Warner Mountains.

2. HYDROLOGY

Twentymile Creek has been gaged continuously since 1945. In addition, there were periods of measurement from 1910-16; 1917-19; 1921-22; and 1940-44. The gaging station, located at about rivermile 20, measures discharge from 196 square miles.

Nearly three-quarters of the average annual runoff of 37,600 acre-feet occurs during February through May. Almost 60 percent runs off in March, April and May. March has the highest mean flow with 134 cfs. With a mean of 1 cfs, September is normally the month with the least flow. Minimum instantaneous discharge has been zero cfs; maximum instantaneous discharge (December 1964) has been estimated at over 3,600 cfs.

Once Twentymile Creek enters the Warner Valley, the stream gradient drops to less than one-tenth of one percent. The slow moving stream has been extensively channelized and ditched to accommodate agriculture. During annual spring run-off, a large amount of water overflows adjacent lands. Water spreads out in numerous sloughs, swamps and depressions. In the lower ten miles, Twentymile Creek mixes with water from Deep Creek and other sources through interlacing of diversion and drainage ditches.

3. FISH RESOURCES

The major fish species in Twentymile Creek are rainbow trout and Warner sucker. Trout inhabit upper portions of the drainage. Warner sucker are found only in the lakes and streams of Warner Valley. These fish live primarily in lakes, but spawn in headwaters of tributary streams. The U.S. Fish and Wildlife Service studied the species and found that its range and numbers have been reduced substantially. The Service listed the Warner sucker as a threatened species October 28, 1985.

Adult and juvenile suckers have been collected in Twentymile Creek near the confluence with Twelvemile Creek. The Service accordingly has designated as critical habitat: 18 miles of Twentymile Creek (nine miles upstream and nine miles downstream from the junction of Twelvemile Creek); and four miles of Twelvemile Creek (beginning at the mouth). This designation includes lands 50 feet on either side of the streams.

The BLM plans to increase trout numbers over baseline levels by 50 percent in public land segments of streams in the Twentymile Creek drainage. It also plans to increase Warner sucker numbers in the public sections of Twentymile Creek that are designated critical habitat.

4. WATER USE AND CONTROL

a) Water Use

Irrigation is the major water use in the drainage. There are rights to irrigate about 7,700 acres. Ninety-seven percent of this acreage is accounted for under decreed rights. Only 200 acres have been applied for and permitted since 1909. In addition to irrigation, there are very limited rights for livestock, wildlife and domestic uses. Use of ground water in the drainage is minimal.

Twentymile Creek is included in the Warner Lakes adjudication of February 8, 1928. Under this decree, irrigators may divert 1/40th cfs per acre prior to June 15th and 1/80th cfs per acre after June 15. The irrigation season is from March 1 to October 1 during which no more than three acre-feet per acre may be diverted.

b) Water Control and Storage

The lower drainage is a network of canals, drainage ditches and levees. Flow is largely unregulated in Twentymile Creek, though some water is pumped from Cowhead Lake in California. Twentymile Creek is diverted into Greaser Reservoir at about rivermile 10.

5. WATERSHED CONDITION

There have been no general inventories of watershed conditions in the Twentymile Creek drainage. The Bureau of Land Management has investigated stream conditions in its Warner Lakes Resource Area, however. The BLM Warner Lakes Resource Area Aquatic Habitat Management Plan (1986) tabulated the following information on stream conditions:

Stream Condition (in miles)					
Stream	Excellent	Good	Fair	Poor	Unknown
Fifteenmile Creek	1.7	1.5	0.9	0.4	0
Twelvemile Creek	0.6	1.8	0.6	0.3	3.9
Twentymile Creek	0.5	0.2	0	0	0

In general, the plan calls for improving habitat by one condition class from that shown above within 10 years, and to maintain those miles which are in excellent condition.

Most of the public land on Twelvemile Creek and some public land on Fifteenmile and Twentymile Creeks was excluded from livestock grazing in 1980. A 160-acre land exchange completed this year brought one additional mile of Twelvemile Creek under public ownership. Future exchanges will include 200 acres and 1.25 miles of stream at the mouth of the canyon. In this area, banks are cut as much as 12 to 15 feet. Another exchange would affect 80 acres and 0.5 mile of stream on the stream in Nevada. The BLM also plans to inventory an additional 10 miles of stream in this drainage.

The plan also identifies three major project areas in the drainage: Fifteenmile Creek, Twelvemile Creek and Twentymile Creek. In Fifteenmile Creek, log and gabion placement will improve spawning gravels and return 200 acres of sage to wet meadow conditions. An additional 1.8 miles of fence on the stream will bring most public lands under intensive grazing management.

Two exclosure fences are planned on Twentymile Creek. One 50-acre exclosure in the upper reach will protect 0.4 mile of stream. The other, just upstream from the mouth of the canyon, would exclude 98 acres and protect 0.8 stream mile. Twentymile Creek in the lower exclosure is currently intermittent, but the BLM believes it will become perennial upon completion of the scheduled protection.

A sedimentation map associated with the Department of Environmental Quality's non-point source assessment (DEQ, 1978) shows severe sedimentation in the Warner Valley reach of Twentymile Creek, and moderate sedimentation in the rest of Twentymile and Twelvemile Creeks.

Data compiled under the Pacific Northwest Rivers Study indicate that Twentymile Creek: 1) often has temperatures exceeding 70 degrees F., 2) has 25 to 75 percent riparian cover, and 3) experiences erosion along 25 to 75 percent of its length.

In summary, the BLM has identified the following needs:

Project Component	Amount	Cost
Fencing Projects on:		
Fifteenmile Creek	0.5 miles	$800
Fifteenmile Creek	0.3 miles	450
Fifteenmile Creek	1.0 miles	1,500
South Twentymile Creek	1.5 miles	2,200
Land Exchanges	440 acres	18,500
Bank Stabilization		
Fifteenmile Creek (gabions)	25 units	6,000
S. Twelvemile Cr. (juniper)	0.25 miles	1,800
N. Twelvemile Cr. (juniper)	0.5 miles	2,600
Pool/Gravel Development		
S. Twelvemile Cr. (boulders)	0.25 miles	1,100
N. Twelvemile Cr. (boulders)	0.5 miles	2,200
Fifteenmile Creek (log sill)	0.25 miles	1,300

C. ISSUE DISCUSSION

1. LACK OF WATER FOR IRRIGATION AND LIVESTOCK

Supplies of water in the drainage are limited naturally by the low amount of precipitation. That only 200 acres have been brought under irrigation since 1909 is also indicative of limited supply. Also, the existence of only one supplemental right in the drainage illustrates not the abundance of water, but its absence. The following table compares the water that has been appropriated versus that normally available (as measured at the gage).

	March	April	May	June	July	August	September
Rights (ac-ft)	12,121	11,730	12,121	8,797	6,061	6,061	5,865
Flow (ac-ft)	8,239	7,914	5,964	3,332	590	209	208

In dry years, not only is irrigation constrained, but stock ponds evaporate, forcing early roundup and feeding.

2. LACK OF WATER FOR FISH HABITAT AND PASSAGE

Use of water for support of aquatic life also is affected by the drainage's arid conditions. Fish numbers in the drainage probably are constrained by degraded habitat—namely, elevated water temperatures and sedimentation. More accurate information is needed for management. Increased inventory measures such as shocking and netting are being proposed by BLM.

There is considerable disagreement regarding the extent to which Warner sucker are threatened, the causes of any declines in population levels, and the habitat needs of Warner sucker. During consideration of the designation of Warner sucker as a threatened species, the U.S. Fish and Wildlife Service received testimony that population levels had not significantly changed during the past several years. In addition, the causes of changes, if any, in Warner

sucker populations are not well-documented. Crappie, a predator, were introduced into the Warner Lakes in the early 1960s and may be having serious impacts on Warner sucker populations.

Fish passage also may be a problem in the drainage, especially for the Warner sucker. The sucker requires passage from Warner Lakes to the headwaters of tributaries for spawning. The U.S. Fish and Wildlife Service found that irrigation diversion structures impeded migration. The BLM, in its Warner Lakes Resource Area Aquatic Habitat Management Plan, noted the existence of an irrigation diversion dam at the mouth of Twelvemile Creek that acts as a blockage to fish passage. During tours of the area in September 1987, members of the Basin Citizens Advisory Committee and agency personnel observed a concrete diversion structure that also blocked fish passage on Twentymile Creek just as it enters Warner Valley. Another diversion, the first on Twentymile Creek (just north of Greaser Reservoir), also may impede fish passage.

D. MANAGEMENT STRATEGY ALTERNATIVES

A variety of strategies may help solve or mitigate the water resources problems in the Twentymile Creek drainage. Some of these strategies can be implemented through Commission action. These strategies generally only affect new water rights. By law, the Commission cannot modify, set aside or alter existing water rights. Most other strategies will require action by other agencies and commissions. The strategies are not mutually exclusive. That is, implementation of more than one of the identified strategies may be appropriate.

1. WATER RESOURCES COMMISSION ACTIONS

a) Withdrawal from Appropriation

In some ways, the drainage has withdrawn itself from further appropriation. There has been virtually no new water development in the past eighty years. Commission action to withdraw the drainage would simply be taking official notice of an existing condition. Although it would not solve the water shortage, withdrawal could protect current users from incidental encroachment by any new water users that might apply in times of surplus. In addition, in view of current conditions, appropriations by new users seem pointless. Withdrawal also could serve as a Commission statement that without augmentation, further development cannot occur. This finding may be a necessary prerequisite to pursuing public funds for reservoir development, should any sites be identified.

b) Classifications and Conditions on New Permits

Permit conditions offer another method of protecting current water users and assuring the highest and best use of the water resource. Placing restrictions on future water rights might help make the most of the limited water supply. For example, a stipulation could be included in future permits requiring that new uses of Twentymile Creek water be based on maximum conservation (use of sprinklers, minimum transmission loss, etc.). Alternatively, classifying the waters of Twentymile Creek only for certain uses might also provide a means for conserving the limited supply. For example, the Commission might only allow non-irrigation or non-consumptive uses such as domestic, aquatic life and pollution abatement on certain waters.

c) Minimum Streamflows

Adoption of minimum perennial streamflows would protect existing flows to the extent that the flows are needed for fish life, pollution abatement or recreation. A minimum streamflow is administered like a water right for instream uses. That is, regulation for a minimum streamflow is based on the priority date of the streamflow in relation to other water rights on the stream. Use of water under senior rights is not affected by adoption of and regulation for the minimum streamflow. Only water rights with priority dates junior to that of the minimum streamflow will be regulated as needed to meet the specified flow level. In addition, adoption of a minimum streamflow would not affect the storage and release of water under existing rights. A minimum flow, however, differs from a water right in that it is an administrative action and can be changed by the Commission.

Minimum flows are also similar to reservations. The quantity of water requested need not be available at the time of the request. Some minimum flow levels, in effect, reserve future volumes of water that might become available through watershed improvements or other water supply augmentation.

2. ACTIONS BY OTHER AGENCIES AND ORGANIZATIONS

The federal government has a large presence in the drainage. The BLM manages most of the drainage. The USFWS has a high level of concern for the threatened Warner sucker. Improvement of the drainage's water resources depends largely on the coordination and level of commitment of these two agencies.

a) Restoration of Riparian Areas

Rehabilitation of riparian areas in the Twentymile Creek drainage would benefit all water uses in the area. Twentymile Creek is essential to the agricultural economy and the native fish of Warner Valley. With healthy riparian areas holding back runoff in the spring, summer water supplies could be increased for both agricultural and fish use.

Riparian area and watershed rehabilitation planned for and in progress on BLM land promises to increase water-holding capacity, especially in the upper drainage. Resultant improvements in summer streamflows and water quality (both temperature and turbidity) would benefit both trout and Warner sucker. Increased water supplies in the summer months would be beneficial to irrigators downstream of BLM holdings.

Treatment of all sites identified in the Warner Lakes Resource Area Aquatic Habitat Management Plan would help improve the drainage's water resources. Additional opportunities for protection might be realized through provisions in allotment grazing plans. Such provisions might include additional stock pond development, riparian pasturing techniques, and grazing exclosures.

Riparian restoration also is needed on private lands in the Warner Valley. Extensive channelization of Twentymile Creek has resulted in a loss of habitat for native fish and has weakened bank structure. Increased management of cattle along stream courses in the drainage would allow riparian areas to recover. This would improve water quality, fish habitat and, ultimately, provide increased forage.

b) Provision for Fish Passage

A voluntary approach to providing fish passage over irrigation diversion dams offers the most hope of success, particularly since the statutes permitting ODFW to order passage refer only to game fish. Warner sucker would be the primary beneficiaries of improved passage on Twentymile Creek. The BLM has indicated that there is no inherent conflict between fish passage and the diversion dam on Twelvemile Creek—that a fish ladder could be installed without affecting the integrity of the dam. Similarly, the U.S. Fish and Wildlife Service in designating the Warner sucker a threatened species noted:

> The Service firmly believes that existing agricultural practices and enhanced conservation of the species are compatible. Modifications to existing diversion structures could be incorporated to enhance movement and survival of the species without changing the purpose or function of the structures. For example, fish screens could prevent diversion of adult and juvenile suckers into agricultural fields. Fish ladders or other passage structures could facilitate movement of the species within streams. The Service will work with the landowners on conservation and recovery of the Warner sucker.

Success of this approach depends primarily on identifying needed structural changes and obtaining funding to effect the changes. Some funding for needed improvements may be available through the USFWS.

c) Evaluation of Warner Sucker Population and Needs

Studies of the status of Warner sucker populations would provide needed information on the extent to which the species is threatened or endangered and the distribution of sucker in the drainage. In addition, further studies could better identify factors which may be limiting for populations. Finally, a better understanding of the habitat needs of the sucker would improve the ability of agencies to manage the land and water resources in a way consistent with the needs of agriculture and the fishery.

SECTION 6
CHEWAUCAN RIVER

A. ISSUE

Lack of water for late-season irrigation, livestock and fish life in the Chewaucan River.

B. BACKGROUND

1. PHYSICAL DESCRIPTION

The Chewaucan River drains roughly 620 square miles in the west central portion of the Goose and Summer Lakes Basin. Rising east of Gearhart Mountain, the river flows north 25 miles to Paisley, where it meets an extensive valley floor. It then runs southeast for 28 miles through Upper and Lower Chewaucan Marsh before emptying into the southern end of Lake Abert. The Chewaucan is formed where Dairy Creek and Elder Creek join. Other major tributaries include South, Coffeepot, Ben Young and Crooked Creeks.

Elevations in the drainage range from 4,255 feet above sea level at Lake Abert to over 8,300 feet at Gearhart Mountain. Rainfall varies with elevation from 10 inches annually on the valley floor to over 30 inches in the mountains.

Most of the drainage is administered by the Bureau of Land Management (54 percent) and the U.S. Forest Service (24 percent). About 22 percent of the drainage is privately owned. Most of the private ownership is on the valley floor west of Lake Abert. The City of Paisley, population 360, is located within the drainage.

2. HYDROLOGY

The Chewaucan River is the largest stream in the Goose and Summer Lakes Basin. It has been gaged continuously since 1924 at a point a few miles upstream from Paisley. The average annual discharge is approximately 104,000 acre-feet. Over 60 percent of the average annual runoff takes place in April, May and June. The maximum recorded discharge took place in December 1964 and was estimated at 6,490 cfs. The Chewaucan has ceased flowing at times due to freezing. There is no regulation by dams in the drainage.

The estimated average annual yield of Dairy Creek is 26,000 acre-feet (WRD, unpublished report, 1984). Watermasters and fishery biologists have observed that Dairy Creek makes a proportionately larger contribution to the Chewaucan yield than adjacent tributaries. Summer

flows appear to be well-sustained, and at times exceed flow levels measured downstream at the Chewaucan gage.

Once the Chewaucan River reaches Paisley, its gradient decreases as it encounters the ancient bed of Lake Abert. Historically, the river probably had many intertwined channels and flowed through extensive marshy areas. However, since modern settlement, the river has been straightened, diked and ditched to serve local agricultural needs.

3. FISH RESOURCES

The Chewaucan River provides the most important fishery in the Goose and Summer Lakes Basin. The river above Paisley contains native redband trout and has been stocked annually with about 9,000 catchable-size rainbow since 1948. Roughly 89 percent of the trout population consists of redband; the remainder are hatchery-reared rainbows. Speckled dace are also present.

Although no thorough population survey has been undertaken, sampling of representative stream sections in 1982 revealed good numbers of redband trout up to 12 inches in length. These trout occupied steep reaches of stream where cover in the form of stream-side vegetation and root wads, boulders and pools was available. Wide, shallow and exposed sections, typical of the stream conditions as it flows through meadows, were largely devoid of trout.

Trout growth is good, with yearling redband trout measuring about 6 inches. Trout two years of age reach 10 inches. Redband trout migrate to spawning areas from March through June. Spawning gravel is distributed throughout the 25 stream miles above Paisley, but is scarce in the rocky canyon sections. Eggs or fry can remain in the gravel into July.

Juvenile trout move downstream to suitable rearing areas as they grow, and as flows recede during summer. Redband trout rear in the entire river above Paisley throughout the year. Although most hatchery rainbow are caught during the season, some survive through the winter.

At present, the river flows above Paisley meet the minimum requirements of the native trout during all but the driest months of drought years. Redband trout have evolved an ability to survive occasional low flow periods and rapidly recover when conditions become more favorable. Impacts of low flows on hatchery rainbow trout are more severe, sometimes causing heavy mortalities.

A fish management plan for the Chewaucan River was adopted by the State Fish and Wildlife Commission in 1983. It calls for managing the river for both native redband and hatchery rainbow trout. The plan emphasizes habitat improvement to enhance wild trout production.

The Chewaucan River receives the most angler use of any stream in the basin. Forest Service roads provide good public access to nearly the entire length of river above Paisley. A 1982 angler survey showed a total use of 3,200 angler days (from opening-day to Labor Day) in which 8,400 hours were expended harvesting about 5,500 trout. These results probably reflect a below-average year because of high flows and inclement weather.

Dairy Creek supports native redband trout, brook trout and hatchery rainbow. Wild redband and brook trout occur throughout the stream, although redband trout are most abundant in the lower reaches and brook trout in the headwaters. About 5,000 catchable rainbow trout are

stocked in the creek each year. A September 1980 sampling showed mean standing crops of 270 redband trout and 260 brook trout per surface acre.

Both species of trout spawn and rear throughout the mainstem of Dairy Creek and its tributaries. Redband trout migrate to upstream spawning areas from March through June; brook trout from September through November. Redband fry may not emerge from the gravel until August; brook trout fry may not emerge until early spring. The tributaries and upper mainstem are nursery areas for juvenile trout.

Dairy Creek is a popular stream for angling. About 6,000 catchable rainbow are stocked each year. Forest Service roads provide good public access. A 1982 survey showed 1,020 anglers fished 2,675 hours to harvest 1,400 trout in the lower 13 miles of the creek. As on the Chewaucan River, the late spring and poor access inhibited early-season use.

In general, redband trout do not inhabit the drainage downstream from Paisley. The Chewaucan from Paisley to the mouth has very little, if any, trout habitat. Willow and Moss Creeks contain speckled dace and tui chub. There have been plantings of rainbow and brook trout into these waters, however.

4. WATER USE AND CONTROL

a) Water Use

Irrigation is the major water use in the drainage. Of the over 22,000 acres irrigated, about 95 percent are located below Paisley. About 45,000 acres are irrigated by surface water. However, ground water development has increased in recent years.

The Chewaucan and its tributaries were adjudicated in 1916. The decree allows varying duties of water and irrigation seasons by claimant. These duties range from 3.9 to 4.8 acre-feet per acre. Seasons may begin as early as January 1 and end as late as September 30.

Another important, but limited, use is by the City of Paisley. The City obtains its water from wells.

b) Water Control and Storage

The drainage below Paisley has been greatly affected by a variety of activities. The river has been diked in the vicinity of Paisley to prevent flooding similar to that which damaged the town in 1964. A network of ditches and canals has been constructed to convey water through both Upper and Lower Chewaucan Marshes.

Three storage sites have been studied in the subbasin: Chewaucan, Coffeepot Creek and Bear Creek (WRD, unpublished rept., 1984). The Coffeepot site on the Chewaucan has been the most extensively studied. First explored in 1912, the project was most recently investigated in 1982. Located at rivermile 40, the reservoir would impound about 115,000 acre-feet and cover 2,660 acres. The stored water would supplement the irrigation needs of about 3,000 acres and provide a new supply for possibly 1,500 additional acres. Under the most recent project proposal, the water would also be used to generate about 9 million kilowatt-hours of electricity annually. The project has not been constructed due to unfavorable economic conditions and concerns about impacts on downstream water uses, reservoir turbidity, and effects on water levels in Lake Abert.

5. WATERSHED CONDITION

There have been no general inventories of watershed conditions in the Chewaucan drainage. However, both the U.S. Forest Service and the Bureau of Land Management have inspected lands under federal management. The Fremont National Forest has identified the following sites that need improvement.

Project Name	Location	Acres	Trend	Rehab Cost
Harvey Cr. Slumps	Harvey Cr.	30.0	Stable	$30,000
Gov. Harvey Gully	Harvey Cr.	2.0	Worsening	16,000
Kates Dairy	Harvey Cr.	0.5	Worsening	5,000
Wooley Cr. Gully	Wooley Cr.	0.5	Worsening	8,000
Ennis Canyon	Ennis Canyon	6.0	Worsening	15,000
Rye Branch Gully	Rye Branch	5.0	Worsening	10,000
Buford & Cat Can.	Buford & Cat Can.	30.0	Worsening	50,000
Coon Hollow / Sage Hen Cr.	Coon Hollow / Sage Hen Cr.	20.0	Worsening	30,000
Meyers Canyon Gully	Meyers Canyon	30.0	Stable	30,000
Chewaucan R.	Chewaucan R.	200.0	Worsening	100,000
Swamp Cr. Gully	Swamp Cr.	10.0	Worsening	25,000
Buck Cr. Gully	Buck Cr.	2.0	Worsening	4,000
Buck-Doe Gully	Buck-Doe Gully	25.0	Worsening	50,000
Elder Cr. Riparian	Elder Cr.	20.0	Worsening	2,000
Gaylord Ranch Gully	Unn Trib to Elder Cr.	1.0	Worsening	4,000
Shoestring Gullies	Shoestring Cr.	3.0	Worsening	15,000
Grasshopper Flat	Unn Trib to Dairy Cr.	1.0	Worsening	7,000
Coffeepot Sprgs.	Coffeepot Cr.	0.5		3,000
Swamp Cr. 2	Swamp Cr.	5.0	Worsening	7,000
Teepee Gully	Teepee Cr.	2.0	Worsening	9,000
Total		393.0		$420,000

The Bureau of Land Management has targeted areas along the Chewaucan River and Moss and Willow Creeks for specific management in its 1981 High Desert Resource Area Aquatic Habitat Management Plan. The BLM proposed to maintain both the riparian habitat and physical stream habitat along 3.8 miles of the river. No management actions were planned for the Chewaucan River.

For Moss Creek, the BLM intended to improve 1.1 miles of riparian habitat from poor to fair condition within five years. It also planned to improve 1.1 miles of physical stream habitat from fair to good within five years. These actions were designed to protect 180 acres. The BLM cited three major causes of streambank disturbance on Moss Creek: 1) inadequate engineering and maintenance on an adjacent county road, 2) highly erodible soils on the uplands immediately to the west, and 3) livestock trailed down the creek bottom.

On Willow Creek, the BLM planned to improve 1.1 miles of riparian habitat from fair to good, and 1.0 miles from poor to fair within five years. The BLM was also to improve 1.75 miles of physical stream habitat from poor to fair, and 0.35 miles from fair to good, within five years. Currently, there are two exclosures on Willow Creek that protect 21 acres. About 2.5 miles of fence were to have been constructed to create two new exclosures and two areas of restricted use. The latter would be used a maximum of two weeks in the spring every other or every third year. Through the use of water gaps and spacing between exclosures, the distance between livestock watering points was kept to less than a mile.

Based on existing exclosures built in 1978, the new projects were expected to show a 100 to 300 percent increase in ground cover in the first two years. A major decrease in the silt load during run-off was also expected. The BLM cites one storm as a basis of comparison. During January 1980, four to six inches of silt were deposited within one exclosure, while less than one inch was laid down in grazed areas above and below the exclosure.

The Aquatic Habitat Management Plan provides the following information:

Stream	Length	Acres	Trend	Management
Chewaucan R.	3.6 miles	8.4	Stable	No change
Willow Creek exclosure)	2.1 miles	34.1	Worsening	Fence (outside
Moss Creek	1.1 miles	1.4	Unknown	Fence

Stream	Aquatic Habitat Condition (percent)			Riparian Habitat Condition (percent)		
	Good	Fair	Poor	Good	Fair	Poor
Chewaucan R.	0	83	17	0	94	6
Moss Creek	0	100	0	0	0	100
Willow Cr.	0	38	62	0	38	62

A sedimentation map associated with the Department of Environmental Quality's non-point source assessment (DEQ,1978) shows severe sedimentation problems on:

- Chewaucan River, mouth to Paisley.
- Willow Creek, entire length.
- Crooked Creek, mouth to rivermile 3.

According to ODFW, the most serious habitat problems in the Chewaucan River are lack of stream side and instream cover, extremes in water temperatures, and siltation of spawning and food-producing areas. A cooperative stream improvement project between ODFW and the Fremont National Forest was initiated in 1982. To date, 2.5 miles of stream have been improved by placement of instream structures, fencing and streambank revegetation. Another 4 miles of stream is scheduled for similar treatment.

ODFW notes that habitat conditions on Dairy Creek are good except for streambank erosion, siltation and lack of stream side cover in meadow areas. The numerous springs in the drainage provide good flows and temperatures for trout in Dairy Creek and in the Upper Chewaucan River. The present streamflow regime in Dairy Creek is adequate to meet the year-round requirements of all fish species.

C. ISSUE DISCUSSION

If all the water rights in the drainage were fully exercised (at an average duty of 4.4 acre-feet per acre), about 220,000 acre feet would be required. This is over twice the average annual discharge of the Chewaucan drainage. The irrigation season, for some lands, begins as early as January and ends in July, reflecting the dryness of the normal growing season. There is perennial interest in storage projects in the drainage, indicating an overall desire for additional water supplies.

Flows in the Chewaucan during dry years are inadequate to meet minimum requirements for native trout. Impacts of low flows on hatchery rainbow trout are more severe, sometimes causing heavy mortalities. ODFW determined monthly flows necessary to meet the minimum requirements of resident and hatchery trout of the Chewaucan River. These flows are met less than half the time in August and October. According to data compiled under the Northwest Rivers Study, temperatures in the Chewaucan can exceed 70° F.

D. MANAGEMENT STRATEGY ALTERNATIVES

A variety of strategies may help solve or mitigate the water resources problems in and along the Chewaucan River. Some of these strategies can be implemented through Commission action. These strategies generally only affect new water rights. By law, the Commission cannot modify, set aside or alter existing water rights. Most other strategies will require action by other agencies and commissions. The strategies are not mutually exclusive. That is, implementation of more than one of the identified strategies may be appropriate.

1. WATER RESOURCES COMMISSION ACTIONS

a) Withdrawal from Appropriation

Given that the duty of water rights in the drainage exceeds the natural discharge by a factor of two, the Chewaucan drainage appears to be fully appropriated. A withdrawal of the Chewaucan drainage would offer a measure of protection to current water users by preventing incidental encroachment by additional water users. A selective withdrawal might allow use of water stored or released from storage, or for other specified uses that would not consume water during the low-water cycle. Ground water may provide an alternate source of water, especially in the lower drainage.

b) Water Reservations

A reservation of water in the amount proposed for the Coffeepot Reservoir might recognize recurring local interest in the project. If it were built, use of the water under the project would have a priority date of the Commission action. This would give users of that water seniority over rights obtained after adoption of the reservation. The reservation might also be adopted with sunset provisions—that is, it could automatically be rescinded if unused after ten years, for example. Adoption of such reservation likely would require Commission evaluation of previously expressed concerns regarding the effects of storage on downstream water uses, reservoir turbidity, and water levels in Lake Abert.

c) Classifications and Conditions on New Permits

The Chewaucan drainage could also be classified only for specific uses. For example, classifying the drainage for non-consumptive or limited uses such as domestic, fish life, fire protection, or pollution abatement would allow continued development of water for those uses. But it would protect existing agricultural water users from conflicts brought on by new users.

Placing restrictions on future water rights could also help assure the best use of the water resource. For example, new permits might be conditioned upon using the least amount of water for the most benefit (use of sprinklers or irrigation system alternatives, minimum transmission loss, etc.).

d) Minimum Streamflows

Adoption of minimum perennial streamflows would protect existing flows to the extent that the flows are needed for fish life, pollution abatement or recreation. If the Commission adopted the minimum flows, the priority dates would be 1988 or later. The flows could only affect rights obtained after the priority dates of the flows and upstream from the gage on the Chewaucan. Given the level of appropriation and the nature of the terrain upstream from the gage, the issuance of additional rights seems unlikely. Domestic and livestock uses and use of stored water generally have been exempted from regulation for adopted minimum streamflow requirements. In rejecting the previous flows, the Commission concluded that irrigation use is a more important use of water.

2. ACTIONS BY OTHER AGENCIES AND ORGANIZATIONS

Almost 80 percent of the drainage area is managed by the federal government. The two agencies involved, the U.S. Forest Service and the Bureau of Land Management, are undertaking projects to improve the water resources of the area. The cooperation of these organizations, as well as of state agencies and private landowners, would permit additional improvement of water resource conditions to the benefit of all users.

a) Restoration of Riparian and Watershed Areas

Restoration of riparian areas in the Chewaucan drainage would improve water resources. Implementation of the Chewaucan River, Moss Creek, and Willow Creek projects identified by the BLM, USFS, and ODFW are important components in any plan to restore riparian areas.

The watershed improvements planned and in progress on the Fremont National Forest promise to increase the water-holding capacity of the upper drainage. The exclosures and grazing management strategies contemplated by the BLM will have a similar impact in the lower drainage.

There is also a need for riparian rehabilitation on private lands, especially in the upper drainage. This does not indicate a lesser need for rehabilitation in the lower drainage. It merely reflects the higher and more immediate return on riparian rehabilitation investment possible upstream from Paisley.

b) Development of Storage

The Coffeepot Creek project offers a method for improving the availability of water for all uses during the late summer and fall. The project has been recently studied, but not undertaken. In any future reviews of the project, opportunities to increase public benefits should be thoroughly scrutinized. These opportunities might best be identified through coordinated resource planning.

SECTION 7
RANGE AND FOREST PRACTICES

A. ISSUE

Effects on streamflow of various forest and range management techniques.

B. BACKGROUND

1. PRACTICES THAT AFFECT WATER RESOURCES

How a watershed catches and releases water depends on many things. Soils, geology, slope, vegetation and climate all interact and give a watershed its characteristic runoff pattern. A watershed's land and water are inseparable. As one changes, so does the other. The two most common land characteristics that are changed by human activity in watersheds are soil character and vegetation. If these two factors are changed sufficiently, streamflow can be affected. Forest and range practices have a direct effect on both.

a) Forest Management Practices

Forest watersheds in an undisturbed condition tend to have a natural balance. That is, over the long term, the amount of water produced, the vegetation composition, and the sediment yield remain fairly constant (U.S. Forest Service, 1987). As forest resources are developed to produce economic and social benefits, the balance may change. Imbalance in forest watersheds often results in damage to water resources. Quantification of the effects of forest management activities has been difficult because of the presence of other factors such as climatic variability and natural disturbances. However, research suggests that timber harvest and road building are the activities that most affect water resources.

1) Timber Harvest

Timber harvest can change the structure and/or the kind of vegetation found in the forest. It can also change the character of soil.

The effect of timber harvest on the volume and timing of streamflow is currently the subject of much research. The interplay of elements in forest hydrology is very complex. Some findings are contradictory, or applicable only to specific regions. The response of a forest watershed to timber harvest is highly individualistic. It will vary according to local climate (pattern of storms, prevailing wind direction, nature of snowfall), forest type (subalpine fir, ponderosa pine, coastal spruce, mid-elevation Douglas fir), or the shape of harvest areas (circular, strip-cuts aligned with wind direction, square), to list just a few variables. There is consensus, however, regarding some points. Harvest techniques which remove most of an area's vegetation, such as clear cutting, affect streamflow in several ways. First, the water that would have been used by the trees that were harvested becomes available for runoff. Also, water or snow that would have been caught by and evaporated from branches of those trees also becomes available. These two processes are called evapotranspiration effects. Second, wind flow changes in the canopy after harvest can redistribute snowfall. This can

significantly increase snow accumulations in the harvested area and decrease it in the surrounding forest. Snow in the harvested area melts sooner in the spring. This increases streamflow during spring runoff and causes earlier peak flows. Redistribution is greatest where snow is cold and dry. In the Cascades, for instance, snow redistribution normally does not occur because of the wetness of the snow. In this case, snow would not be deeper in clearcuts, but would still experience early melting (Troendle and Leaf, 1981).

Of evapotranspiration and redistribution, the first probably contributes most of the "extra" water. A study in the Rocky Mountain region suggests that about two-thirds of the observed change in streamflow can be attributed to these evapotranspiration effects. The snow redistribution effect, however, can be longer-lived than evapotranspiration effects. It is likely to persist until the canopy is reestablished, which may take from 20 to 50 years (Troendle, 1983).

Some research suggests that it may be possible to manipulate forests to increase water yield. However, any benefits from increased yield will be offset if the result is an increase in peak flows. When attempting to manipulate forests, managers must take precautions to avoid increased peak discharges and the resulting erosion, sediment production, and channel instability. Annual water yields have been observed to increase anywhere from 20 to about 40 percent over pre-harvest levels (Troendle, 1983). It is generally held that 20 to 30 percent of a watershed must be harvested before a significant change in flow can be detected (Troendle and Leaf, 1980). Optimal harvest design to increase yields appears to consist of small, irregularly shaped openings that are about three to eight tree heights wide and parallel to the wind (Troendle, 1983).

There is disagreement as to whether harvest increases the magnitude of peak flows. Karr and Dudley (1981) state that, in general, land surface modifications result in more severe and more frequent flood peaks. Coats and Miller (1981) cite numerous studies that found increases in small stormflow peaks associated with reductions in evapotranspiration. Similarly, in the Wagon Wheel Gap (Colorado) study where the entire watershed was clearcut, peak discharge increased up to 50 percent (Bates and Henry, 1928; Van Haveren, 1981). In an Alberta study, researchers observed 1.5 to 2 times higher storm peaks in watersheds where 35 to 85 percent of the area was cut (Swanson and Hillman, 1977). On the other hand, on two other Colorado watersheds there was no increase in peak discharge (Troendle and Leaf, 1981; Troendle, 1982).

Clearcutting can also lead to landslides. This effect is a serious problem in western Oregon forests. It generally is not significant east of the Cascade Mountains. As roots remaining in the soil after harvest rot, the soil mantle is deprived of support. If the harvest area is on a steep slope, landslides may result. Sediment from landslides often is deposited into streams. Stream channel capacity is reduced and, at elevated flows, may force water over banks. The degree to which clearcutting contributes to landslides depends on the type of trees involved, the soil, slope, and climate. Douglas fir areas in wet climates are particularly susceptible. In one study, timber harvest increased the landslide rate 5 to 19 times above the forest level. About 40 percent of all landslide debris produced in the watershed was delivered directly to streams of third order or greater (Reeves et al., 1987). [Stream order classifies a stream on the basis of its tributaries. A stream without tributaries is a first order stream. Where two first order streams join, the result is a second order stream. Thomas Creek at the National Forest boundary is an example of a third order stream.]

There is also disagreement about harvest effects on low flows. Karr and Dudley (1981) maintain land surface modifications also increase the severity and frequency of low flows. Swanson and Hillman (1977) observed an apparent increase in flow in the late summer in

some Alberta watersheds. This may be due to summer precipitation, however, as opposed to some delayed distribution of increased yields from harvest.

Soil compaction associated with harvest activities such as timber skidding and yarding can affect streamflow. When soils are compacted, less water infiltrates and more water runs off. Soils may take from 20 to 40 years to recover from compaction (U.S. Forest Service, 1987) or they may take much longer.

Results from the Alsea Experimental Watershed (Harr et. al., 1975) and from the Coyote Creek study (Harr et. al., 1979) suggest that 12 to 15 percent surface compaction is enough to significantly increase large stormflow peaks. Garland (1983) reported that as much as 40 percent of a harvest area could be compacted by skid trails. An analysis of discharge frequency for the Coyote Creek study indicated that a nine-year flood could be increased in magnitude by 40 percent. This would require, for example, replacement of 18-inch diameter culverts with 30-inch culverts to handle the higher discharge.

2) Road Building

Road networks are, in effect, alternative drainage systems imposed on the landscape. Road cuts intercept zones of subsurface flow. A compacted road surface has a very low rate of water infiltration. Compacted road surfaces and roadside ditches collect and concentrate surface water. Road networks are frequently dendritic and thus mimic the naturally efficient design of drainage channels. Because roads add miles of channel to a watershed, water can be delivered to streams much more rapidly than under natural conditions (U.S. Forest Service, 1987). Increased peak discharges have been observed in small basins where road densities are high (Harr et al., 1975). Interception of subsurface flow by road cuts can also increase runoff rates (Megahan, 1972; King and Tennyson, 1984).

Road construction in riparian areas can change the nature of streamside vegetation and alter channel structure. Both can influence the pattern of stream discharge. Like clearcuts, roads can also trigger landslides. This problem is most serious west of the Cascade Mountains. Roads cause far more landslides than timber harvesting, however. Reeves et al. (1987) report that in their Elk River study, roads increased the landslide rate 27 to 108 percent over natural levels. Although roads produced more debris than timber harvest, this material was normally delivered to first and second order streams. Channel capacity in these streams would be reduced and streamflow changes could result. The degree to which roads trigger slope failures depends on rock and soil types, road design, slope and climate.

b) Grazing Management Practices

Grazing can change vegetative cover over entire watersheds and thus affect streamflow. However, grazing affects streamflow most directly through soil compaction and vegetation removal in riparian areas.

There is general agreement that Western range conditions today are much improved over denuded, deteriorated rangelands of the early 1900s (Busby, 1979). This finding is probably not true for riparian areas, however (Platts, 1979). Where ranges are over-used, soils become less permeable and runoff increases. A study by Gifford and Hawkins (1976) indicated that most current grazing strategies failed to significantly increase plant and litter cover on watersheds. The strategies appear to benefit only certain plant species; that is, where one plant species increases in density, another decreases, and the net effect may be no increase in watershed protection. In addition, range managers have historically combined uplands and

riparian areas under a single grazing management strategy (Stream/Riparian Management Short Course, 1986). This has led to overuse of riparian areas by livestock.

Riparian areas attract many species. Wildlife, livestock and people all enjoy the proximity to water and cover these areas offer. Although wildlife and human use can damage the riparian environment, the potential for damage is probably greatest with livestock (especially cattle).

Riparian areas occupy small areas, but are very important in terms of forage. Elmore (1987) states that riparian areas account for less than two percent of most forests and less than 0.5 percent of rangelands. However, these areas frequently produce ten times more forage than adjacent forested uplands. Similarly, the Forest Service (U.S. Forest Service, 1987) indicates that they occupy about two percent of range areas, but they can potentially produce 20 percent of the forage on a grazing allotment. The riparian zone plant and soil associations also function to regulate streamflow by acting as a sponge. Porous banks absorb water during fall and spring high flows and release it during dry periods (Braun, 1986).

The forage, relatively gentle terrain, shade, and water lead cattle to prefer riparian areas over drier, steeper surroundings. If unmanaged, cattle concentrate in riparian areas and cause damage. Soils in riparian areas are usually moist and particularly susceptible to compaction owing to the weight and number of cattle. Also, woody vegetation such as willows can be browsed down, sheared off, or trampled by livestock. Vegetative recovery can be slowed or stopped as re-emergent trees and shrubs are eaten as fast as they appear. Without the stability provided by roots, streambanks are eaten away. Depending on the local geology, the stream may entrench and its channel become wider and shallower (Braun, 1986).

As the stream entrenches, the surrounding water table drops. This may kill off much of the remaining vegetation in the riparian area. Without roots or input of logs and branches to form pools and dams, less water is held back. If improper grazing management continues, cattle walking along the banks cause increased bank caving. These interactions can promote increases in streamflow fluctuations (U.S. Forest Service, 1987) or can even result in the stream going dry in late summer.

2. APPROACHES TO MITIGATE EFFECTS ON WATER RESOURCES

a) Forest Practices

There are a number of techniques used to avoid or mitigate water resource problems in forest management. These include:

- Limiting harvest to a certain percentage of any watershed at any given time.
- Selecting harvest methods or a mix of methods to reduce the amount of cleared land present at any one time in a watershed.
- Reforesting areas or re-establishing vegetative cover soon after harvest.
- Protecting forest riparian areas
  - through harvest restrictions
  - through proper road design
  - through appropriate livestock management

- Road management
  - using existing network where possible
  - revegetation or closure of unnecessary roads
  - scaled-down design of new roads (no wider than necessary; steeper grades to lessen extent; etc.)
  - careful road siting (avoid riparian areas, steep side slopes, unstable soils, etc.)

b) Grazing Practices

Grazing, when properly managed, poses no threat to water resources. Generally, measures which protect water resources also benefit rangeland resources. Properly managed riparian areas, for instance, can support more grazing than mistreated riparian areas. For example, Elmore (1987) reports that in 1974 a degraded riparian pasture on Bear Creek was licensed for 74 AUMs. Twelve years later, after rehabilitation, the same pasture was licensed for 280 AUMs. Because of the increased forage, the permittee's hay bill was reduced by $10,000.

There are a number of techniques in range management that can help assure compatibility between grazing and water resources. In formulating grazing strategies, the following options should be considered (Stream/Riparian Management Short Course, 1986):

- Control of
  - grazing frequency, including complete rest.
  - livestock stocking rates.
  - livestock distribution.
  - livestock kind and age class
  - season of forage use.
  - levels of forage use.

- Active rehabilitation of damaged riparian areas.

The most promising grazing strategies for maintaining or rehabilitating riparian areas may include (Stream/Riparian Management Short Course, 1986):

1. The inclusion of the riparian pasture as a distinct management unit.
2. Changing the kind of livestock (from cattle to sheep in certain areas).
3. Adding more rest to the grazing cycle.
4. Reducing the intensity of streamside forage use.
5. Controlling the timing of forage use.
6. Managing allotments as specified in allotment plans.
7. Fencing streamside corridors, generally as a last resort.

C. ISSUE DISCUSSION

In the Goose and Summer Lakes Basin, timber harvest and grazing are among the most important economic activities. Lake County, for instance, received an average of over

$3.4 million annually from 1977 - 81 from U.S. Forest Service receipts alone (U.S. Forest Service, 1987). The sale of cattle and calves for the county in 1987 accounted for over 70 percent (about $ 23 million) of all agricultural sales (OSU Extension, 1987). Timber harvest and grazing are not only important in terms of economic return, but their management has important implications for Basin water resources. In the following discussion, information pertaining to the Fremont National Forest is derived from the Forest's Draft Environmental Impact Statement [DEIS] (U.S. Forest Service, 1987).

The county contains nearly 1.5 million acres of forested land. Of the commercial forestland, over 73 percent is managed by the Fremont National Forest. The Forest Service is now developing a plan to manage forest resources over the next fifty years, with planning updates every ten years or so.

The Fremont is predominantly an old-growth forest. The Forest Service is proposing to allow harvest of 132 million board feet annually, but is considering alternatives that would allow 118 to 158 million board feet. According to the Fremont National Forest Draft Environmental Impact Statement, even-aged harvest systems will be the predominate vegetative management treatment under all alternatives. The most common even-aged system would be clear-cutting. Over the next ten years, anywhere from 7,600 to over 13,000 acres would be clear-cut, depending on the alternative. The proposed Forest plan calls for clear-cutting 12,300 acres during this period.

The Fremont has about 5,400 miles of stream channels. Under all alternatives, the Forest Service plans to restrict timber harvest along these streams. Areas protected in this manner account for almost 24,000 acres.

Watersheds on the Fremont are generally in stable, good condition. Gully erosion, though, is severe in the Coffeepot, Chewaucan, South Creek, Hay Creek, and Abert Lake watersheds. The most widespread watershed problem, however, is the forest transportation system.

The Fremont has a very high road density, about 3.68 miles per square mile. This compares to a stream density of only 2.6 miles per square mile. The Forest is considering alternatives to construct or re-construct 60 to 112 miles of road in the next ten years. The proposed Forest plan calls for nearly 100 miles of new or re-constructed road in this time period.

Soil compaction can occur on all forest soils, but is most severe on basalt-derived soils. About 40 percent of the Forest has a high potential for compaction. Most timber sales on the Forest display some compaction, with extensive compaction evident in a few cases. The Forest Service attempts to mitigate for compaction by requiring cable logging systems, limiting tractor operations when surface soils exceed recommended moisture levels, and breaking up skid trails and landings after operations. The Forest Service is considering alternatives in which timber harvest would take place on 7,000 to over 11,000 acres of unstable soils in the next ten years. The Forest Service preferred plan would allow timber harvest on over 9,000 acres of unstable soil in this period.

Currently, about 20 percent of the Fremont National Forest's 73 grazing allotments are being damaged by livestock use. Most of this damage is to riparian areas. Several allotments have had long-term overuse in the recent past by unauthorized livestock. Production of desirable forage plants on many of the small meadowlands within allotments is suppressed because of overgrazing. The Forest now supports about 71,000 AUMs annually. Under the alternatives described in the DEIS, the allowable number could range from about 59,000 to over 80,000 AUMs annually for the next ten years. The Forest preferred alternative calls for a level of about 76,000 AUMs.

Roughly 44 percent of the allotments have areas of unused, or lightly used, available forage. Livestock use of these areas cannot be expanded until range improvements that will prevent resource damage have been completed. Limited funding for both permittees and the National Forest has slowed development of understocked allotments. In some cases, rehabilitation of damaged riparian areas may require temporary exclusion of livestock. Most riparian management objectives, however, can be met by adjusting the amount and intensity of livestock use.

The Bureau of Land Management administers drier, lower elevation lands in the basin. The BLM has inventoried some of its watershed conditions and has developed aquatic habitat management plans to address some of the problems that have been found. In the High Desert Resource Area aquatic plan (BLM, 1981), Buck, Silver, Bridge, Willow, Moss and Pine Creeks, as well as the Chewaucan River have been targeted for treatment. About 15 miles of stream and over 70 acres will be involved in range improvements and changes in grazing strategies. The Warner Lakes Resource Area aquatic management plan (BLM, 1986), identifies about 10 miles of streams in poor condition. Projected improvements include fencing, bank stabilization, pool/gravel development and land exchanges. Project descriptions for selected streams may be found in the issue papers on individual streams found elsewhere in this document.

Timber harvest and grazing are common on private lands in the basin. About 26 percent of Lake County's commercial forestland is privately held. Most valley land, as well as significant blocks of forest meadowland, is also privately owned and used for livestock grazing. The problems caused by timber harvest and grazing that have been described for federal lands are also present on private lands. For example, a recent study of the Cox-Bauers Creek watershed (Lasater, 1987) found that excessive stream channel erosion has affected the economic and natural resources of the Goose Lake drainage basin. The degraded condition is a result of practices intended to increase crop, timber, and livestock production. The watershed, however, has a high potential for rapid improvement. A coordinated resource management plan is now being written to achieve this potential.

D. MANAGEMENT STRATEGY ALTERNATIVES

Water resources problems or opportunities presented by timber harvest and grazing are beyond the regulatory control of the Water Resources Commission. There are means available, however, to influence such activities. Most involve coordination and cooperation with other agencies. These could include:

1. WATER RESOURCES COMMISSION ACTIONS

1. Direct staff to work closely with other agencies that affect water resources, especially on a stream-specific level. Opportunities include commenting on:

   - National Forest land & resource management plans
   - BLM & U.S. Forest Service grazing allotment plans
   - Local Comprehensive plans
   - Other state agency plans
   - Dredge & fill permits

2. Contact and brief other commissions, agencies, and the public about water resource impacts of timber harvest and grazing.

3. Direct staff to develop brochures or libraries of information regarding water resource impacts of timber harvest and grazing.

2. ACTIONS BY OTHER AGENCIES AND ORGANIZATIONS

Local governments and federal and state natural resources can urge riparian area and watershed protection of all streams which are in good condition and rehabilitation for degraded streams.

Federal land management agencies can seek agency and Congressional funding at adequate levels to allow rehabilitation all identified degraded sites.

State agencies can recommend legislation to provide funding for watershed enhancement activities and to lower application fees for stock reservoirs and watering sites to improve the distribution of livestock over range lands.

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SECTION 8
MINING ACTIVITIES

A. ISSUE

Impacts of mining activities on water quality in the basin.

B. BACKGROUND

There are three areas of concern that relate to mining activities in the basin: the uranium mill site at Lakeview, the White King and Lucky Lass uranium mines along Augur Creek and the proposed gold mine at Quartz Mountain. All are located in the Goose Lake Subbasin.

The White King and Lucky Lass uranium mines were operated between 1955 and 1960. The mines are in the Fremont Mountains approximately 14 miles northwest of Lakeview. During the period of operation, approximately 130,000 tons of ore were taken from the mines. Other radioactive materials were excavated at the mines and deposited near the mine pits.

The ore was ground and then leached with sulfuric acid and sodium chlorates at the mill site near Lakeview. The mill tailings which remained after uranium processing were deposited at a site north of Lakeview. In addition, evaporation ponds were constructed at the site to provide for disposal of waste water produced during ore processing. The Oregon Department of Energy has completed cleanup of the tailings disposal site. The tailings and contaminated soils have been moved to a site approximately 7 miles north of Lakeview. The contaminated materials have been covered with a one-foot thick compacted earthen cover. The cover is capped with a two-foot thick layer of rock to protect from wind and water erosion. Finally, a mixture of rock and soil was placed over the site and was seeded.

Local contamination of surface and ground water at the original tailings site has occurred. A leachate plume is present beneath the uranium mill site in Lakeview. The Oregon Department of Energy has been monitoring the plume. The plume appears to be slowly moving to the west and southwest. Sulfate, antimony, chromium, iron, cadmium and manganese have been detected in the shallow aquifer approximately 800 feet west of the mill site. The deeper zone (60-75 feet) shows high sulfate concentrations, possibly because of intermingling with geothermal water.

The uranium ore body at the White King and Lucky Lass mines contains arsenic. The water which fills the mine pits dissolves the arsenic compounds. At times, particularly during spring runoff, contaminated water flows from the mine pits into Augur Creek. While Augur

Creek undoubtedly contains arsenic, the extent of the contamination in the stream and surrounding soils has not been determined. Dilution by other sources of flows in Augur Creek may be adequate to reduce the contamination to safe levels downstream of the mine sites.

No major rehabilitation activities have occurred at the two uranium mine sites. Open, water-filled pits and tailings piles are present at both sites. The sites are readily accessible to the public. A few signs are present near the lake which warn of contaminated water.

The proposed Quartz Mountain gold mine will consist of open mine pits and a heap leaching facility. Quartz Mountain is approximately 25 miles west of Lakeview. The ore which is removed from the pits will be ground and placed on leaching pads. A cyanide solution will be used to remove the gold from the ore. Any problems at the proposed mine would probably be more in the area of water supply than water quality. A water supply for the mine operations has not been identified. It is probable that ground water will be used. Consultants for the mining company anticipate that the proposed open pit mining activities will intercept ground water flow to the spring supplying domestic water to several homes in the vicinity. Lakeview Water Users, Inc. has expressed concern that the open pit mine will intercept snow melt that would otherwise flow to Drews Reservoir.

C. ISSUE DISCUSSION

1. URANIUM MILL SITE

The mill tailings have been moved and the hazards represented by the presence of radioactive materials have been resolved. Final landscaping at the old tailings site was completed during the summer of 1988. Some erosion has been experienced at the new disposal site. The erosion problem should have been resolved with completion of final work at the site in 1988. However, precautions are needed to ensure that contaminated runoff does not reach Camp Creek, a tributary to Thomas Creek.

There are about 40 domestic wells within a mile of the mill site. While a plume of contaminated ground water can be detected at distances of up to 1,000 feet from the former mill tailings site, present data do not indicate tailings or evaporation pond seepage reaching privately-owned domestic wells down gradient of the site.

Soluble arsenic present in the ground water seems to be associated with the geothermal system rather than the tailings pile or evaporation ponds. There is arsenic in the tailings, but that has now been relocated to a permanent disposal site. Arsenic at Hunters Hot Springs, about one-quarter mile northeast of the site, reaches levels of 0.23 milligrams per liter. Up gradient water samples indicate manganese quantities above secondary standards, probably also from the geothermal aquifer.

To date, a definite plan to clean up the contaminant plume at the mill site has not been adopted. There should be a reduction in contaminants in the aquifer down gradient from the tailings site now that tailings have been removed. Naturally occurring arsenic and sulfates will no doubt still be present, since they are contained in the geothermal aquifer.

2. WHITE KING AND LUCKY LASS URANIUM MINES

The U. S. Forest Service has requested and may receive funding to assess the need for remedial action at the White King and Lucky Lass mine sites to control the spread of radioactive materials and arsenic. There are no data available to quantify the probable contamination of Augur Creek by water flowing from the mine pits. As a tributary to Thomas Creek, Augur Creek has already been withdrawn by the Water Resources Commission from all uses except for domestic and livestock and the use of stored water.

3. QUARTZ MOUNTAIN GOLD MINE

The area in the watershed surrounding the Quartz Mountain mine site is about 6.5 percent of the total area in the Drews Reservoir watershed. The mine site is in the extreme upper part of the watershed. Since all drainage from the site will not be eliminated, the impact to flows into the reservoir will probably be minor. Seasonal variations in precipitation are probably greater than the potential impacts from mining. Additionally, the mine operator can be required to grade the site so that the maximum amount of precipitation can still flow into Drews Creek.

The Departments of Geology and Mineral Industries and Environmental Quality require licenses and permits to mine the ore and to operate the leaching facility. In addition, a water right will be required for any wells or surface water diversions constructed to supply either the mine site or the leaching facility. The license to mine would undoubtedly be conditioned to require control of runoff to reduce turbidity. The permit to operate the leaching facility will require extensive precautions against release of cyanide.

The proposed gold mining activities would occur on lands managed by the U.S. Forest Service. As a result, an Environmental Impact Statement will be prepared prior to initiation of the mining. The mine operators also will be required to submit operating plans to the Forest Service for review and approval initially, and prior to any significant changes in operations.

D. MANAGEMENT STRATEGY ALTERNATIVES

1. WATER RESOURCES COMMISSION ACTIONS

a) Withdrawal from Appropriation

Aquifers that are contaminated or in danger of becoming contaminated can be withdrawn from further appropriation. Existing water rights will not be affected. The aquifer surrounding the uranium mill site, the ground water bodies near the uranium mines and, if contamination occurs, the affected streams and aquifers at Quartz Mountain, can all be withdrawn. However, such an action would not provide any relief for the existing water users.

The Commission can further extend the Thomas Creek withdrawal order to include domestic and livestock use of Augur Creek to prevent ingestion of arsenic.

b) Water Rights Review

Water right holders may protest issuance of a water use permit to the Quartz Mountain gold mine if injury to existing rights may result. If protests are filed, the Water Resources Department will hold a hearing to determine if a permit should be issued.

c) Environmental Impact Statement Review

Department staff has participated in scoping meetings to identify issues to be addressed during preparation of the Environmental Impact Statement (EIS) for the gold mining activity. The Department can continue its involvement by providing data for use during preparation of the EIS and can review the draft EIS and comment on the adequacy of the analysis with respect to impacts on water resources.

d) Monitoring Program Development

Department staff could assist in development of monitoring and surveillance programs to ensure that contaminants from the mill tailings disposal site do not leach into Camp Creek. The Oregon Department of Energy is developing a monitoring program to provide early detection should materials leach from the site. Staff could provide hydrogeological expertise in designing and conducting the programs.

2. ACTIONS OF OTHER AGENCIES

Activities directly related to mining, except for the use of water for mining and ore processing purposes, are outside the jurisdiction of the Water Resources Commission. The Commission can make recommendations to the licensing agencies, but cannot dictate terms of mine operation.

Since the expected dewatering of a domestic spring at Quartz Mountain would be the result of mine operations, the Commission would not have the authority to require a replacement system, nor could the Commission prevent mining in the vicinity of the spring. The mining company has offered to replace the existing domestic water system with an updated system that will not be disturbed by mining.

Construction and management of the heap leach ore processing area will be subject to strict control by the licensing agencies. Effects of altering the landscape will be addressed in the U.S. Forest Service Environmental Impact Statement.

The mill tailings disposal site is expected to prevent movement of radioactive materials and heavy metals into the water supplies for the Lakeview area. However, the potential exists for some leakage to occur. Careful monitoring of water in Camp Creek and of ground water in the area of the new tailings disposal site would identify any contamination of water supplies and permit an early response to any problems which may be detected. In addition, a periodic sampling program of Augur Creek would provide needed data regarding arsenic levels being contributed by overflow from the White King and Lucky Lass mine pits.

SECTION 9
SMALL RECREATION IMPOUNDMENTS

A. ISSUE

Potential for development of small recreation impoundments to contribute to improvement of the local economy.

B. BACKGROUND

1. NEED FOR IMPOUNDMENTS

The Goose and Summer Lakes Basin contains many lakes which provide still-water recreation opportunities. However, the larger of these lakes are at the lower ends of closed basins and the poor water quality is not conducive to water-contact activities. In addition, the lakes generally are too saline to provide high-quality fishing. There are a number of small lakes in the higher areas of many of the drainages which are suitable for recreational use. Several of these are reservoirs which have been constructed to store water for irrigation use. Others have been constructed primarily for fish, wildlife and recreation purposes. About half of the lakes which are stocked were developed by the Bureau of Land Management. Most of the rest are on Forest Service lands.

The Oregon Department of Fish and Wildlife currently stocks 20 to 25 lakes in the basin with fingerling trout each year. The trout are approximately 6 months old when they are planted in the lakes and generally are of catchable size a year after they are released. At the point that they enter the fishery, they have grown to 9 to 11 inches. After the first year, the rate of growth is approximately 3 inches per year. However, because of the fishing pressure, most of the fish that are caught are yearlings or two-year olds. Few hatchery trout survive to the third year. Because of the increasing pressure on the fishery, the size and catch rates of trout have declined during the last decade. Demand for warm-water fishing, although much smaller in magnitude, also is rapidly increasing.

One large reservoir in the basin, Thompson Valley, has provided a productive trout fishery in the past. However, the reservoir also contains populations of roach which necessitate periodic treatments with rotenone. After the treatments, the roach quickly repopulate the reservoir to the detriment of the trout. Treatment of the reservoir has been due for the last two years.

The fishery in some of the reservoirs in the basin is limited by low water levels during the late summer and fall. When demands for irrigation water exceed natural streamflows, the stored water is released to augment supplies. Water rights for storage of water specify the uses to be supplied under the right. Where the impoundment has been developed by an irrigation district or private party for irrigation purposes, the uses of the stored water, and thus the reservoir levels, depend on the needs of the developer. Many reservoirs in Oregon are operated by federal agencies. These agencies' responsibilities include consideration of the needs of fish and wildlife and recreation when making operational decisions. In the absence

of some form of public contribution to the development of impoundments, the probability that the reservoirs will be managed in a manner compatible with other uses is reduced.

In 1975, Lake County revenues generated by tourism were estimated at $1.7 million. According to the draft Fremont National Forest land management plan, recreational use of the forest averaged 192,000 visitor days annually between 1976 and 1980. About 58 percent of this use involved fish and wildlife resources. The mean annual value of the fish and wildlife resources was estimated at $4,231, 400. The Forest Service expects heavier use of the fisheries, especially by local people.

Local governments throughout the state currently are in the process of developing regional strategies for economic development. The purpose of the process is to identify local priorities for development and to direct state programs toward projects which support those priorities. Lake County is considering a regional strategy which emphasizes tourism. However, the draft report discussing the strategy appears oriented more toward attraction of tourists to scenic resources than to the area's fishery resources.

2. FUNDING OPPORTUNITIES

The three agencies which historically have had the authority and responsibility for development of small recreation impoundments are the Forest Service, Bureau of Land Management and Oregon Department of Fish and Wildlife. The Forest Service has participated in development of impoundments in cooperation with other agencies. For example, construction of the dam expanding Dog Lake was funded by the Forest Service and Department of Fish and Wildlife. The funds used by the Forest Service were appropriated for the Dog Lake project. For other projects, unspecified fish and wildlife habitat improvement funds could be used. A third possible source of funding to the Forest Service may be through the use of Knutsen-Vandenberg (K-V) funds. The source of K-V funds are the proceeds from timber sales, a portion of which are dedicated to watershed improvement projects within the area of the timber sale. Where the potential impoundments are within future sale areas, the K-V funds could be used on the project.

The Forest Service is nearing completion of a planning process intended to identify the way in which the land and resources will be managed during the next ten to fifteen years for the benefit of all users. The recently-released draft plan proposes planning for and construction of three recreation impoundments during the planning period. The Fremont National Forest will be expected to include in budget requests adequate funding to permit the planned development. However, other priorities may prevail when the local budget needs are compared with those of other agencies. The differences between budget requests and actual funding levels can be significant.

The Bureau of Land Management has developed a number of small impoundments in the basin for stock watering. However, the funds available for BLM recreation programs have never been significant. Fisheries generally have been a side benefit to stock water projects. No additional projects of sufficient size to support a fishery currently are planned. Exclosure fences have been constructed around parts of many reservoirs to provide enhanced fishing opportunities.

The Oregon Department of Fish and Wildlife provided partial funding for the expansion of Dog Lake. Most funding for the activities of the department is from a combination of federal funds, state general funds, and hunting and fishing license fees. During recent years, the ability of the department to fund habitat improvement projects has decreased. Currently, only

$200,000 to $225,000 in state and federal funds are available each biennium for these projects.

Recreation impoundments are eligible for funding under the Community Development Block Grant program administered by the state Economic Development Department. The federal funds and a portion of state lottery funds provide the sources of money for the program. The program is intended to assist in capital improvements which will provide new job opportunities in the area. During recent years, however, most of the funds have been used for water and sewage system improvements. The large number of these types of projects needed and the health hazards presented by deficiencies in present systems have effectively resulted in the exclusion of other types of projects from the program.

C. ISSUE DISCUSSION

Development of additional impoundments in the basin would permit release of more fish and would relieve some of the pressure on the existing lake fishery. It is not clear what effect enhanced fishing opportunities would have on the ability of the basin to attract tourists and to realize the resultant economic benefits. Given the many lakes and reservoirs between Lake County and the major population centers, it is unlikely that new impoundments would attract large numbers of fishermen from outside the basin. If the primary users of the enhanced fishery were basin residents, development of additional impoundments may not result in increased tourism revenues. In addition, there are questions regarding the economic impacts of enhanced fishing on the local area. Many believe that the impacts are minimal because the fishermen tend not to use local motels and restaurants. However, to the extent that basin residents took advantage of the enhanced fishing opportunities in the basin instead of traveling outside the basin, the transfer of funds out of the basin would be reduced.

Small impoundments dispersed throughout the basin also offer significant fire protection benefits. Many small reservoirs have been developed in other areas of the state to improve water availability for fighting forest and range fires. These reservoirs can be used by helicopters and fire trucks during fire fighting operations. The impoundments also could contribute to a slowing of runoff and extension of summer streamflows.

Development of small reservoirs has slowed dramatically during recent years. Most projects constructed in the state have depended on large contributions of federal funds. In order to reduce the federal budget deficits, federal agencies have adopted more stringent economic criteria for funding projects. The result is that few projects, and particularly those dependent on federal funds, currently are underway.

Federal land management agencies have a statutory responsibility to provide for all uses which occur on federal lands. Many of the high-elevation, headwater areas which are particularly suited to small impoundments capable of maintaining quality fisheries are on lands managed by the federal agencies. Consistent with this responsibility, the agencies have developed several impoundments in the basin which provide important recreational benefits. The agencies also have developed many impoundments which may not be used to full potential. The current level of use of the impoundments suggests that improvements in the management of the existing impoundments or the development of additional impoundments are needed.

The State of Oregon never has contributed significant levels of funding to development of water projects. The Water Resources Department does not have the authority to construct and operate reservoirs for any purpose. The Department of Fish and Wildlife has developed a number of small impoundments throughout the state to provide habitat and fishing

opportunities. In addition, the statutes permit state payment for the public benefits of projects developed by other public or private sponsors. The program is administered by the Water Resources Department. If the Department approves payment for public benefits, a request for an appropriation of funds for the project is submitted during the next Legislative session. In addition, the Governor's Watershed Enhancement Board funds projects to improve streamside conditions. These projects will improve habitat conditions for fish and wildlife thereby enhancing fishing and hunting opportunities in the area. In many cases, riparian rehabilitation may provide a more economical way to improve recreational opportunities.

D. MANAGEMENT STRATEGY ALTERNATIVES

The federal land management agencies have the responsibility and authority to develop and manage small recreation impoundments on federal lands. The agencies can seek line item appropriations to fund small projects or can use funds dedicated to fish habitat and recreation purposes. The agencies also can improve conditions at the existing impoundments which they manage.

Local governments can use the regional strategies process to direct state agency attention to the need for development of small impoundments. A strategy to encourage tourism, particularly outdoor recreational activities such as fishing and camping, could include, as one element, the development of the small impoundments which would support and enhance these activities.

Any person or organization considering development of an impoundment can incorporate features which provide recreational opportunities. To the extent that these features provide public benefits, the project sponsor may be eligible for reimbursement for the benefits provided.

A water right will be required for any reservoir which is developed. Prior to issuing a permit to begin development of an impoundment, the Water Resources Department will evaluate potential effects of the project on existing water rights.

SECTION 10

SILVER STATE WATER AND POWER PROJECT

A. ISSUE

Protection of the interests of Oregon water users from any adverse effects of the proposed Nevada well field near the Oregon border.

B. BACKGROUND

The proposed Silver State Water and Power Project consists of about 50 large capacity wells to be drilled in central and northern Washoe County, Nevada for municipal use. The purpose of the project is to develop ground water for use in the Reno-Sparks area. Additional features of the project would be pipelines, pumping plants, conventional hydroelectric power projects and pumped storage hydroelectric power projects. Several hundred miles of pipeline would service the scattered 50 wells in order to transport water to Reno-Sparks. The project would cost as much as $150,000,000 and require over 20 years to complete.

Three of the proposed wells are within 10 miles of the Oregon state line. Because they are in Nevada, permitting is under jurisdiction of the Nevada State Engineer. Each of the three wells is projected to have an output of five cubic feet per second. If operated at capacity throughout the year, each well would pump 3,600 acre-feet of water. The well applications which have been filed in Nevada provide the following information:

- Application 50219 is for a well in Coleman Valley at Township 47 North, Range 20 East, Section 11, Mount Diablo Base and Meridian. At the site of the proposed well, about one mile from the Oregon border, the estimated recharge from Nevada is 1,000 acre-feet per year.

- Application 50241 is for a well to be located at T46N, R18E, Section 21, MDB & M, about seven miles from the border. The site is near Barrel Springs, tributary to Twelve Mile Creek which drains to Warner Valley. Estimated recharge at the site from Nevada is 2,000 acre-feet per year.

- Application 50225 is for a well to be located in upper Guano Valley, at T46N, R21E, Section 12, MDB & M. The site is about five miles from the border. Recharge from Nevada at the site is estimated at 7,500 acre-feet per year.

Protests against Applications 50219 and 50241 were filed with the Nevada State Engineer by Oregon ranchers. Application 50225 was not protested by any Oregon party.

C. ISSUE DISCUSSION

The capability of the wells to produce the quantities of water identified in the applications has not been established. While the proposed production levels may be possible on an intermittent basis, the wells may not produce at those levels for extended periods. Adequate

data are not available to provide a high level of confidence in assessment of the ground water potential in the area. The wells are in the upper reaches of their respective watersheds. It is probable that recharge to the aquifers would not keep pace with discharge at maximum pumping rates.

Based on available data, the effect on water users in Oregon probably will be minor. The nearest Oregon ground water right is more than ten miles from any of the wells. Some reservoir and surface water rights are a few miles closer. The distances to Oregon wells, streams and reservoirs is great enough and the proposed diversions small enough that significant injury is unlikely. However, in each case, the proposed well site is located in a valley which drains to Oregon. On that basis it is not possible to say that there will be no impact on streams or ground water recharge in Oregon. The first influence would be to capture water in Nevada that would otherwise flow to Oregon as surface or ground water.

D. MANAGEMENT STRATEGY ALTERNATIVES

1. WATER RESOURCES COMMISSION ACTIONS

a) Authority

Oregon has no authority to "control" water allocation activities in another state, even if affected watersheds include parts of Oregon.

b) Compact

Where issues are contested or where an agreement potentially affects vested rights, the Commission may seek a formal compact with the adjoining state. Depending on the provisions of a compact, congressional approval of its terms may be required. Even if not required, congressional approval may be desirable.

c) Supreme Court Apportionment

Where two states reach an impasse in division of a common water resource, the disadvantaged state can seek apportionment of the source in the United States Supreme Court.

d) Intervention

The adjoining state may, but is not required to, allow the Commission to intervene on behalf of a party alleging injury to an existing water right.

2. ACTIONS BY OTHER AGENCIES AND ORGANIZATIONS

a) Petition the Water Resources Commission

An individual could pursue any one or more of the above actions, through the Oregon Water Resources Commission. In order to do this, the individual would petition the Commission to take the desired action.

b) Protest

Oregon water users may file protests against the proposed project with the Nevada State Engineer, but Nevada is not required to accept the protests.

c) Private Lawsuit

The individual may also pursue a private suit for damages against the water user(s) in the adjoining state. The state is not a necessary party to such litigation, although under particular circumstances, states might choose to request party status.

SECTION 11
ALKALI LAKE

A. ISSUE

Protection of air and water quality from the herbicide residues buried near Alkali Lake and from occurrence of similar contamination incidents.

B. BACKGROUND

In the late 1800s, a Portland firm filed mining claims on Alkali Lake for boron. Tests showed little boron in the deposits, so no mining was done. Early in the 1900s, an English company took options on the lake for soda ash. World War I interrupted that operation. Another Portland company bought the claims in 1967 in order to establish a waste chemical storage facility.

The Oregon Department of Agriculture licensed the site in 1968 for pesticide waste storage. By 1971, 25,000 55-gallon drums of phenolic wastes had been stored at the site. These wastes primarily were from distillation residues from the manufacture of 2,4-D (2,4-dichlorophenoxyacetic acid) and MCPA (4-methyl-2-chlorophenoxyacetic acid). The Departments of Agriculture and Environmental Quality stopped the storage of hazardous wastes that year.

In 1976, the State of Oregon took possession of the site. The waste drums had begun to leak, so the Oregon Department of Environmental Quality let a contract to have the drums crushed and buried in shallow, unlined trenches. Most of the barrels were crushed and a 4-foot high fence was placed around the site of the trenches. Some barrels remain exposed in the area to the south of the burial site. Periodic ground water samples show that phenols have entered the shallow ground water aquifer. A plume of contaminated ground water has been shown to be moving down gradient to the west of the burial site.

There also is industrial waste at Alkali Lake. Early in the 1970s, a pilot plant for the production of titanium from rutile ore was operated in Albany. Although uranium and thorium decay series are normally associated with rutile, the waste hauled to Alkali Lake apparently was not tested for radioactivity. Given the source of the waste, it is possible that the radioactivity levels exceed Oregon standards for the disposal of nuclear wastes. The waste was placed in shallow trenches southeast of the controlled (fenced) area and covered with soil. The area is not marked. Soil, water and air samples have not been taken.

C. ISSUE DISCUSSION

The U. S. Environmental Protection Agency funded two studies of the disposal site area. The studies, published in 1984 and 1985, traced the migration of the contaminant plume to the west in the direction of the ground water flow under the disposal site. Recommendations for containment of the plume were not part of the studies.

The Department of Environmental Quality has continued to periodically monitor the migration of the phenolic plume in the ground water. The latest series of samples, taken in October 1986, indicated that there may now be some lateral movement of the plume in a northerly direction. Most of the off-site samples taken, including wells near Highway 395 to the east of the disposal site, showed low levels of phenols. DEQ suspects sampling and analysis errors, and not an interconnection with the ground water at the disposal site, to be the cause of the appearance of phenols in the samples taken from many of the sites.

The Hutton Springs tui chub, unique to the Alkali Lake basin, is found in Hutton Springs, at the north edge of Alkali Lake. The species may be eligible for endangered or threatened designation. The rate of migration of the plume toward the springs and the potential effect on the springs, if any, are unknown. The spring are at a higher elevation than the contaminated ground water. As a result, under current climatic conditions, movement of water in the shallow aquifer is away from Hutton Springs.

A 1971 report prepared by the Department of Geology and Mineral Industries concluded that Alkali Lake is a closed drainage basin. Artesian flows in two wells in the area establish that the deep fresh-water aquifer is separated from shallower water zones by confining layers of sedimentary rock. The occurrence of several large fresh-water springs in the vicinity of the lake playa show that ground water is moving into the basin; thus, liquids placed on the ground surface are not likely to escape the lake basin. In addition, the artesian flows from the deep fresh-water aquifer should prevent phenols from contaminating water in that aquifer.

D. MANAGEMENT STRATEGY ALTERNATIVES

1. WATER RESOURCES COMMISSION ACTIONS

The Water Resources Commission has the authority to withdraw both surface and ground water when it appears that appropriation of the waters may constitute a hazard to the user. The Commission can therefore withdraw the waters already contaminated and also the waters that are likely to be contaminated in the future. The present boundary of the existing phenolic waste plume has been established. The eventual area that may be contaminated cannot be established with certainty with existing data, since it appears that the plume is still slowly moving.

2. ACTIONS BY OTHER AGENCIES

The Department of Environmental Quality is continuing to monitor the phenolic waste plume. The area containing the titanium processing waste has not been surveyed. There are no known actions planned by any of the environmental protection agencies to clean up the site.

The site does not meet current state siting criteria for the disposal of radioactive wastes. If the titanium processing waste is radioactive enough to be accepted at Hanford, state statutes

require that it be shipped there. If the level of radioactivity is lower, then a site certificate for the current location must be secured or the wastes must be shipped to another disposal site which meets the siting criteria or is out-of-state. Such a site is not currently available. A site in Utah may be available in the near future.

It is not certain that the waste plume constitutes a hazard to the Hutton Springs tui chub. If future study shows that a hazard does exist, and the species warrants protection, the U.S. Fish and Wildlife Service can adopt measures to intercept the waste plume and remove the solid wastes.

SECTION 12
GEOTHERMAL RESOURCES

A. ISSUE

Potential benefits and effects of geothermal development.

B. BACKGROUND

There are a number of areas in the Goose and Summer Lakes Basin where hot ground water occurs. In and near Lakeview, hot ground water occurs in the vicinity of Hunters Lodge and in the vicinity of Barry Ranch. A number of hot wells have been drilled on the Rockford Ranch south of Lakeview. At least three hot wells have been drilled near Paisley with apparently significant temperatures and flow rates. Thermal water discharges at the surface at Summer Lake Hot Springs. There are additional areas of warm or hot water elsewhere in the basin including a number of features in Warner Valley. Evaluation of water chemistry suggests sub-surface temperatures may be as high as 336 degrees F. at one site, Fisher Hot Springs.

Of all these areas of shallow geothermal ground water, the anomaly around Hunters Lodge appears to be the largest. Here the resource currently is being used for space, water and greenhouse heating. This is the area of the well-known Lakeview Geyser.

In the early 1980s, developers drilled a well in Hammersly Canyon near Lakeview and installed modular generating units with the hopes of developing the resource for electrical generation. This project failed, apparently due to interference with private wells by the production well and the lack of a favorable power sales contract. The interference question was never resolved by a long-term pumping test. The problem of effluent disposal also was never resolved.

Temperatures as high as 234 degrees F. have been measured in drill holes in the Lakeview area, and discharge temperatures of springs have been measured as high as 205 degrees, which is boiling at the elevation of the springs. Although the chemistry of the geothermal water suggests that the maximum water temperatures may be as high as 300 degrees in the deep subsurface, no temperatures above 234 degrees have actually been measured.

Under Oregon law, geothermal water below 250 degrees is managed under the same statutes as non-thermal ground water. Above 250 degrees, thermal water is managed as a mineral resource, similar to oil and gas. Depending on whether geothermal water is above or below 250 degrees it is referred to as a high-temperature or low-temperature resource. High-temperature geothermal resources come under the jurisdiction of the Department of Geology and Mineral Industries, while low-temperature geothermal resources come under the jurisdiction of the Water Resources Department. It probably is safe to assume that any geothermal resources developed in the basin in the near future will be below 250 degrees and come under the jurisdiction of the Water Resources Department.

C. ISSUE DISCUSSION

1. POTENTIAL USES

There are a number of potential uses for low-temperature geothermal resources. For all these uses, the benefit is derived by using the thermal energy in the water to offset the cost of using other energy sources. Low-temperature geothermal resources typically are used for space heating, water heating, greenhouse heating, grain drying, industrial processing or any other use requiring temperatures up to that of the geothermal water. While technology exists to use low-temperature geothermal resources for electrical generation, it is not a particularly efficient use of the resource and the economic feasibility is generally low.

2. BENEFITS

Benefits to individual homes or businesses using geothermal resources include lower energy costs and possibly government incentives. Less money leaving the community for outside energy is a benefit to the community. The community also may benefit if the resource is sufficiently large to attract industry or to support a district heating system. In some areas, geothermal resources have been developed to attract tourism.

3. COSTS

Geothermal development also has environmental and social costs. As geothermal aquifers are developed, natural features such as hot springs or geysers can diminish and even dry up. Large developments may affect pre-existing developments or uses, as may have been the case with the Hammersly Canyon development. Potential developers need to consider the impacts to the natural geothermal features and other resource users.

4. OTHER CONSIDERATIONS

Effluent disposal is another consideration. Developments often must dispose of large volumes of spent geothermal fluid. Re-injection back into the geothermal aquifer helps to maintain pressure, but can reduce temperatures. Injection into other aquifers may dispose of the effluent, but does not help to maintain pressure in the geothermal resource and may affect other beneficial uses of the receiving aquifer, particularly drinking water uses. Discharge of effluent to surface water bodies is another option, but adverse environmental impacts can result due to the thermal or chemical character of the effluent. The geothermal water at Lakeview exceeds U.S. Environmental Protection Agency primary drinking water standards for arsenic, and secondary standards for boron and fluoride.

There must be sufficient understanding of the geology and hydrology of a geothermal resource before its potential can be evaluated by developers or by resource managers. Without good basic knowledge of the geothermal aquifer or aquifers, there is no sound basis on which to plan development, and no way to evaluate proposed development or estimate the impact.

Limited information is available to characterize the aquifers in the Lakeview area. Experience in the area suggests that many of the geothermal wells are hydraulically connected, and that large-scale development in the geothermal aquifer may affect existing users.

D. MANAGEMENT STRATEGY ALTERNATIVES

Technical staff at Water Resources Department can review all geothermal water right applications from the Lakeview area and estimate the potential for significant impact. If serious interference is likely, consideration would be given to denying the application.

The Water Resources Department could conduct a resource assessment of the geothermal area to determine the hydraulic characteristics of the aquifer, estimate the maximum development potential, and recommend such things as well spacing, well construction and effluent disposal methods.

The Water Resources Department, Oregon Department of Energy, Lake County, and Town of Lakeview could initiate a cooperative study of the potential benefits and costs of development of a geothermal heating district in the Lakeview area. Such a study should consider the impacts of further development of the resource on existing users.

SECTION 13
PERMANENT BASIN COMMITTEE

A. ISSUE

The need for a committee to develop unified basin positions on water-related issues and to provide basin involvement in the decisions made by public agencies.

B. BACKGROUND

Several counties have organized committees to provide advice on water-related matters. The Douglas County Water Resources Advisory Committee was created by the county board of commissioners. The committee worked with the Water Resources Department during formulation of the Umpqua River Basin Program. Since then, the committee has been given the responsibility for advising the county on water management issues. In addition, the committee continues to be active in representing the local community in matters before the Water Resources Commission. Josephine County created a similar committee after work on the Rogue River Basin Program was completed.

The John Day River Basin encompasses parts of 11 different counties. After completion of the basin planning process there, several of the counties adopted ordinances creating a basin council and appointed county representatives to the council. The purpose of the council is to promote the implementation of the basin plan and to address the water-related problems of the basin. Proposed activities of the council include promoting improvement of the watershed, education, identification of needed watershed improvement projects and representing basin citizens in legislative and agency decision-making processes.

During past legislative sessions, the Lake County Commission generally has appointed a committee to advise on proposed legislation. The committee has been composed of local water users. The purpose of the committee has been to monitor the activities of the legislature and to recommend county positions on water-related bills which would affect the county. In the past, the committee has only been active during the legislative sessions.

Many state agencies have organized citizens committees to provide input during decision-making processes. These committees generally are organized to advise on a specific issue and disband after a decision is made. The creating agency generally sets the agenda for the committee. As a result, such committees often are not able to effectively provide input to other agencies which may also be engaged in related activities. In addition, the ability of the committee to participate in the legislative process tends to be limited.

C. ISSUE DISCUSSION

Management of water and watersheds is a critical issue for all citizens. Many activities of governmental agencies and individuals can have profound effects on all kinds of water users including irrigators, cattlemen, fishermen and boaters. Government continually is involved in policy deliberations regarding resource management. Local citizens' concerns may not be well-represented during these deliberations. As a result, information which is important to

the decision-making process may not be available. In addition, the members of the community may not have a good understanding of the issues to which the agency is attempting to respond or an opportunity to participate in deliberations prior to the formal hearing stage of the decision-making process.

The involvement of local citizens in the decision-making process also is an important component in the effective enforcement of any regulations which are adopted. An understanding of and participation in the decision to impose regulation can improve local acceptance of the regulations. In the absence of general voluntary compliance with the regulations, the costs of enforcement become almost prohibitive.

Many decisions which affect water and, therefore, water users are not made by government. Most of the decisions relating to the management of private lands are beyond scope of governmental authority. The education of private land owners regarding the effects of various management practices on downstream water uses and the benefits to themselves of good watershed management is the most effective way to ensure the protection of these resources. A local citizens committee offers one method for encouraging land owners to improve the management of their lands.

The Goose and Summer Lakes Basin is almost entirely within Lake County. As a result, a committee organized by the county commission to advise on water-related issues affecting the county would effectively constitute a basin advisory committee. Such a committee would help to ensure local input into federal and state agency rule-making actions and legislative deliberations. The committee also could work with local landowners to encourage the use of improved watershed management techniques.

It frequently is difficult for citizens committees to draft original materials, to travel to and participate in meetings at distant locations and to closely monitor agency and legislative activities. The time commitments and costs involved in performing these tasks can be prohibitive for many committee members. Committees composed of voluntary, part-time members generally are most efficient and effective when their primary activities involve review and comment on reports and other products prepared by others. A staff person assigned to the committee can prepare materials for review and approval by the committee. In addition, a staff person can help in monitoring agency activities and in coordinating the committee's participation in those activities.

D. MANAGEMENT STRATEGY ALTERNATIVES

There are two basic alternatives available if creation of a permanent committee to advise on water matters is desirable. The committee could be created by action of the Water Resources Commission or by action of the Lake County Commission.

1. WATER RESOURCES COMMISSION ACTION

The Water Resources Commission could create and direct the Department to staff a permanent advisory committee. The Commission likely would retain appointment authority for such a committee and would define the committee's responsibilities.

2. LAKE COUNTY COMMISSION ACTION

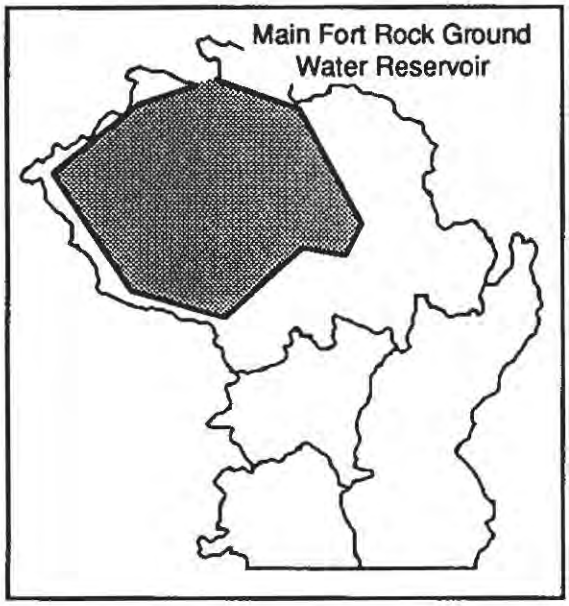
The Lake County Commission could appoint a water resources advisory committee to recommend county actions with respect to water management. The committee also could be

charged with the responsibility to represent the community in federal and state agency and legislative decision-making processes and to advocate sound watershed management in the county. The assignment of a staff person, at least on a part-time basis, would enhance the ability of the committee to perform these functions.

SECTION 14
FORT ROCK/CHRISTMAS VALLEY

A. ISSUE

Effects of the administrative withdrawal of ground water resources and of changes in the agricultural economy in the Fort Rock/Christmas Valley area on ground water levels.



B. BACKGROUND

The Water Resources Department published a report on ground water conditions in the Fort Rock-Christmas Valley area in 1986. The Fort Rock Basin, as it was called in the report, lies within the northern part of the Goose and Summer Lakes Basin. The area has been experiencing a decline in ground water levels since the mid-1970s. Based on the conclusions in the report, the Water Resources Commission withdrew the main ground water reservoir from further appropriation for most uses.

Concurrently with the administrative action restricting new uses of ground water, economic conditions resulted in a virtual halt in agricultural development in the area. Hay prices dropped to a level which not only did not support cultivation of additional acreages, but also forced some lands out of production. In addition, many farmers in the area have taken lands out of production and have placed them under the federal Conservation Reserve Program. Under state legislation passed in 1987, water rights on lands under the Conservation Reserve Program are not considered abandoned by virtue of five consecutive years of nonuse. However, there are not formal requirements for notification of the watermaster by owners of lands under the program.

C. ISSUE DISCUSSION

Most of the ground water development in the Goose and Summer Lakes Basin has taken place in the Fort Rock-Christmas Valley area, where permits have been issued for irrigation of about 65,000 acres. Agricultural development in the Fort Rock/Christmas Valley area has a history of major fluctuations. With a short growing season and arid climate, a period of either unfavorable economics or of inadequate water can have serious impacts on the productivity of the area.

There is a main ground water reservoir in the Fort Rock area which contains an abundance of generally good-quality water. This reservoir is the source of all ground water for irrigation

and most other purposes. Pumpage from the reservoir since 1976 has averaged about 75,000 acre-feet annually. Prior to 1972, annual pumpage was less than 20,000 acre-feet.

Recharge to the main reservoir in the Fort Rock area is from precipitation falling in the area. Precipitation appears to take about one year to infiltrate down to the main reservoir. Annual recharge is estimated at about 140,000 acre-feet per year. Under natural conditions, about 10,000 acre-feet appear to seep north to the Deschutes Basin, 90,000 acre-feet south to the Summer Lake Subbasin, and the remaining 40,000 acre-feet are lost through evapotranspiration.

In the basin lowlands, water levels in the main ground water reservoir display changes of less than 1.1 feet annually and altitudes of 4,285 to 4,300 feet. These water level changes are very similar throughout the basin and reflect the recharge/discharge balance to the volcanic and sedimentary aquifers of the reservoirs.

Pumpage from the main ground water reservoir is approximately equal to the average recharge to the reservoir as monitored in the lowlands. Restoration of long-term equilibrium conditions will probably require more than 100 years. Average decline rates will slowly decrease from the present rate of 0.4 foot per year during the transition back to equilibrium. During this restoration period, water levels in the reservoir should decline less than 70 feet from current levels. This drop is expected to result in reduced subsurface discharge to the Deschutes and Summer Lake Basins and reduced evapotranspiration by native vegetation in the Fort Rock area.

When the Fort Rock main ground water reservoir was withdrawn from appropriation for most uses, the Water Resources Commission included a sunset clause which requires a review of ground water conditions in the area in 1990. To facilitate the review, monitoring of pumpage and water levels is being continued. Data developed during the study of the reservoir suggests a relationship between flows from Ana Springs and Fort Rock ground water reservoir levels. However, the data are not adequate to accurately predict the effects of continued ground water level declines on Ana Springs. Additional study is needed to better establish any correlations between ground water levels and spring flow.

D. MANAGEMENT STRATEGY ALTERNATIVES

1. WATER RESOURCES COMMISSION ACTIONS

Limitations on new appropriations have helped to prevent further overdraft of the main ground water reservoir. This action has placed a theoretical limit on pumpage. The limit is temporary because the withdrawal will be automatically rescinded in the absence of Commission action in 1990.

Depending on results of the review planned for 1990, the Commission may be able to rescind the withdrawal or permit some amount of new irrigation water use. However, if the review reveals continued declines in reservoir levels, it may be necessary to place some restrictions on existing uses.

Analysis of the correlation between flows from Ana Springs and levels in the Fort Rock main ground water levels would provide a better understanding of the effects of continued ground water use.

2. ACTIONS BY OTHERS

Several irrigators in the valley have placed farm lands under the federal Conservation Reserve Program. State legislation passed in 1987 exempts lands under the program from the statutory provisions under which water rights which are not used for five consecutive years are forfeited. If economic and climatic conditions improve within five years after expiration of the Conservation Reserve Program, irrigation can be resumed using the still valid water rights. One major purpose of the Conservation Reserve Program was to take highly erodible lands out of production. However, it may be possible to transfer water rights from lands under the program and to begin cultivation of other equally erodible lands nearby. Federal action could close this loophole in the program.

SECTION 15

GOOSE LAKE WATER QUALITY AND LAKE LEVELS

A. ISSUE

Recent declines of water quality and water levels in Goose Lake.

B. BACKGROUND

The information in this section, except where noted, is taken from the Atlas of Oregon Lakes, Oregon State University Press, 1985.

Goose Lake is a large but shallow water body located southwest of Lakeview. It covers approximately 97,400 acres and averages eight feet in depth. Although 65 percent of the surface area is in California, nearly 66 percent of the lake's drainage area lies in Lake County, Oregon. The lake has a surface elevation of about 4,700 feet above sea level. It lies on a semi-arid plain and is surrounded by the Warner Mountains to the east, the Fremont Mountains to the north, and a series of ridges to the west. To the south, a low gravel terrace separates the lake from a marshy former river channel that leads to the North Fork Pit River.

1. WATER LEVEL

Goose Lake derives its water supply from direct precipitation, streams and springs. Historically, Goose Lake has varied greatly in size and volume, ranging from being completely dry to overflowing into the North Fork Pit River drainage. For example, it was dry in 1926 and nearly dry each summer from 1929 to 1934. The lake is said to have overflowed in 1868 and 1881.

The closed-basin lakes of the region are continuously undergoing cycles of expansion and retreat. A recent study of Goose Lake (Nebert, 1985), based in part on tree ring analysis, suggests that the late 1400s, late 1600s, and the middle of this century were marked by high lake levels. The study also indicates that the Goose Lake basin experienced severe water deficits of five years or greater three times in the last 543 years—in the late 1420s, mid-1630s, and from 1925 to 1939.

Fluctuations in Goose Lake elevations are felt most in Oregon because of the nearly level topography on the north end of the lake. The following statistics are derived from California's report, "Goose Lake Water Quality Control Policy Basic Data Report" unless otherwise noted. The most recent maximum lake level of 4,705 feet occurred in 1957. At that point, Goose Lake covers about 35,000 acres in Oregon, or roughly 3,000 acres more than it does now. At the over-flow elevation of 4,716 feet, the area covered by Goose Lake in Oregon is about 43,500 acres, or about 12,000 acres more than its present extent. At that level, the lake's northern boundary would migrate three miles north of its present position to within a mile of the Lakeview airport.

2. WATER QUALITY

Goose Lake has water quality characteristics typical of closed basin, alkali lakes. It is more dilute, however, than other nearby lakes, such as Abert and Summer Lakes. The main dissolved minerals are sodium, carbonate and bicarbonate and chloride. Evaporation concentrates the major ions, as well as algal nutrients and other dissolved substances. The lake is rich in phosphorous, having the second highest concentration in a recent survey of over 200 Oregon lakes. The water transparency is extremely low because wind-driven waves disturb bottom sediment.

Currently, the Oregon Department of Environmental Quality manages Goose Lake water quality to protect the following uses: livestock watering, trout rearing, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, and commercial navigation (Oregon Department of Environmental Quality, 1976).

The California Water Quality Control Board (California WQCB) characterized Goose Lake water quality in a 1966 study (California WQCB, 1966). First, it indicated that there are no direct discharges of sewage or industrial wastes to the lake, although the Lakeview sewage lagoon effluent may eventually be delivered to the lake. Secondly, the interchange of poor quality water between aquifers, or the intrusion of brines from improperly constructed wells or highly mineralized springs appear to have a minor affect on the water quality of Goose Lake. Lastly, the Department found that the major factors causing water quality impairment in Goose Lake are irrigation projects, water project developments (reservoirs), and adverse salt balances caused by evaporation. Evaporation is the most important factor in Goose Lake water quality degradation.

The California report also characterized some of the individual measures of water quality and how they affect water uses. The following classification is an interpretation of, but does not appear in, the report. Generally, there are physical water quality parameters that are at desirable levels, and others that are not. Accordingly, some water uses are unaffected while others are constrained. These parameters and uses are summarized below.

a) Physical Water Quality Parameters

1) At or Near Desirable Levels

1. Temperature - Goose Lake water temperatures probably coincide with mean daily air temperature. Thus, temperatures vary from about 40 (due to insulating winter ice) to 67 degrees. This range is appropriate for water contact sports and fisheries.

2. Algal growth - Goose Lake has very limited algal growth. The limiting factor may be a lack of some nutrient, the pH, or turbidity. Excessive algal growth can interfere with recreation and aesthetics.

3. Biological Oxygen Demand - This parameter is used to determine the degree of organic pollution in water. Values indicate Goose Lake has the capacity to assimilate additional organic wastes.

4. Water Hardness - Hardness describes the soap consuming potential of water. Goose Lake waters are soft to slightly hard.

2) At Undesirable Levels

1. Turbidity - Goose Lake is turbid and increases in turbidity from north to south. Turbidity lowers recreational use, although it may prevent undesirable algal blooms. Also, the turbidity results from clay particles, not more objectionable organics.

2. Color - Turbidity aside, Goose Lake has a pronounced light tan to reddish brown color. The color has been measured at 70 units. Many water users object to water that has color exceeding 15 units.

3. Dissolved solids - Although less saline than some nearby lakes, Goose Lake still has very high salinity. When water surface elevations are below 4,702 feet, less beneficial use of water is possible due to salt concentrations.

3) Requiring Additional Sampling

1. Radiation levels - California collected one sample from Goose Lake for radiological analysis. Radiation levels were concluded to be within safe limits. California WQCB recommended continued radiological sampling.

2. Toxicological levels - One water sample was collected from Goose Lake in 1966 and analyzed for pesticide residues. None were detected. Fish samples were also collected and analyzed, but results were not available at the time of report publication.

b) Water Uses

1) Not Constrained by Current Water Quality

1. Wildlife - Goose Lake is heavily used by migrating waterfowl. This use is not contingent upon water quality.

2. Scenic Attraction - Although the lake's turbidity and color detract from its aesthetics, its extent and setting offer an impressive vista which is unrelated to water quality.

3. Livestock watering - There is no evidence to suggest stock using the lake as a watering source have suffered from its quality.

2) Constrained by Water Quality

1. Irrigation - Goose Lake has been used on a limited basis for irrigation. However, according to California WQCB, because of sodium and boron concentrations, "it is really not suitable ... [and] probably more harm than benefit results from its use".

2. Fisheries -According to California WQCB, "Prior to 1926, when the lake went dry, a minor fishery for trout existed in the lake, primarily ... in Oregon. Currently, angling for rainbow trout in the lake is almost non-existent." Also, although warm water gamefish (yellow perch, brown

bullhead, bluegill and sunfish) have been introduced, none have done well. The reasons for the decline of the trout fishery and the limited reproduction of warm water fish are not known. However, fish populations are probably sensitive to changes in the lake's water quality.

3. Recreation - Because of the decline of fish populations, fishing is not an important recreational use of water on the lake. Swimming is fairly limited because of the turbidity, bottom sediments, as well as the shallow nature of the lake. Boating is limited because of the unaesthetic nature of the lake waters and because of lack of access and launching facilities.

4. Industry - Goose Lake water is a poor source for industrial uses because of turbidity, color, alkalinity, dissolved solids and iron content. Treatment is not economically feasible. Industrial use has never been made of the lake water. Future use is unlikely.

5. Domestic - When lake levels are high, water quality is probably adequate for domestic use. However, such use is rare and future use is unlikely.

C. ISSUE DISCUSSION

According to the California Water Quality Control Board (1966), water levels in Goose Lake have been dropping recently. Although climate is the over-riding factor affecting lake levels, it is possible that water consumption through irrigation may play some role. For example, the Atlas of Oregon Lakes states that about 85,000 acre-feet of water is consumed annually from streams tributary to Goose Lake. This is roughly one third of the total estimated annual inflow to the lake. Similarly, Nebert (1985) suggested that the most recent low water period was aggravated by irrigation water withdrawals which decreased streamflow to Goose Lake. The construction of reservoirs in the basin may also decrease the amount of water flowing to the lake by increasing water area exposed to evaporation (California WQCB, 1966).

As lake levels drop and lake volume decreases, water quality worsens. The total dissolved salt concentration is inversely proportional to the quantity of water in the lake. When water surface elevations exceed 4,702 feet, the water quality of Goose Lake is improved to the point where increased beneficial use of the water may be made (California WQCB, 1966).

Falling water levels would be expected to affect recreational and fisheries water uses the most. Irrigation would not be greatly affected because lake water is not very suitable for this purpose and has never been widely used as a source (California WQCB, 1966). As lake volume decreases, the potential for higher temperatures, turbidity and salt concentrations increases. Such increases would not benefit currently depressed fish populations. The character of lake water would further discourage swimming and boating.

Other possible effects of lowered lake levels might include: increased lands available for agriculture; decreases in wetland and waterfowl habitat; stranding of boating facilities; increased velocities and cutting in tributary streams due to changes in base level; and micro-climate changes.

D. MANAGEMENT STRATEGY ALTERNATIVES

Because the major factor in Goose Lake water levels and quality is climate, very little can be done to affect either. Some studies suggest that consumptive use of water may aggravate

low-water conditions. It may be possible to reduce that consumption through water conservation measures. Assuming 85,000 acre-feet currently are consumed in the Goose Lake Basin (Atlas of Oregon, 1985), if an ambitious and successful program were implemented perhaps 20 percent of that amount could be conserved.

If this entire amount, about 17,000 acre-feet, were delivered to the lake at once, the lake might rise about two inches above its present level. Seventeen thousand acre-feet represents roughly two percent of Goose Lake's present volume. In actuality, the conservation savings would not be added all at once, but parceled out through the season. The addition of such a small amount of water into the lake system would be negligible from both a lake level and water quality standpoint.

It has also been theorized that reservoirs in the basin act as evaporation pans and contribute to Goose Lake water loss. The surface area of reservoirs in the basin is not excessive, however. Any attempt to restrict future reservoir construction for this reason would be inappropriate, as the benefits derived from storage probably far outweigh any minor consequences to Goose Lake water levels or quality.

Enhancing Goose Lake water quality to increase recreational opportunities is probably beyond the scope of any jurisdiction. The major problems are lake depth, sediment, and wind which combine to cause turbidity. Little can be done about any of these elements on a broad scale. However, recreational opportunities might be expanded for specific sites through structural means. For example, break-waters, dredging, and sheltering belts of vegetation may alter a specific site sufficiently to allow increased recreational use. Because the affect of water quality on fish populations is uncertain, efforts to improve the trout fishery are probably best directed toward habitat improvement on tributary streams. In the case of warm water fish, further study might be required to identify which factors are limiting reproduction.

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SECTION 16
BOOTH STATE PARK

A. ISSUE

Degraded stream conditions in Antelope Creek which affect Booth State Park.

B. BACKGROUND

Booth State Park is twelve miles west of Lakeview on Highway 140. It covers over 300 acres and borders Antelope Creek. The park has only a small developed area. Facilities include 6 picnic units, drinking water and restrooms. No camping is allowed. In fiscal year 1986-87, almost 35,000 visitor-days were spent in the park.

Antelope Creek is roughly fifteen miles long and flows into Goose Lake from the northwest. Both the creek and watershed are fairly small, the latter having an area of about 25 square miles. Only about six square miles of the watershed are above Booth State Park.

The park's major attractions include semi-natural vegetation, wildlife and scenery. The riparian corridor along Antelope Creek is especially important for watchable wildlife, such as birds.

C. ISSUE DISCUSSION

The state Parks Division is concerned with maintenance of adequate water levels in the creek. The stream usually goes dry in July. In places the creek is deeply eroded, with vertical banks that frequently slough. Both these conditions harm riparian vegetation and its associated wildlife.

Highway 140 is adjacent to Antelope Creek for about three miles in the vicinity of the park. The Division believes that construction of the highway may have confined and re-routed streamflow, causing channelization. This, in turn, has degraded the park's riparian area.

The Parks Division is also concerned with the quality of the park's drinking water. One well that was drilled within the last five years had to be abandoned because of high iron content.

D. MANAGEMENT STRATEGY ALTERNATIVES

There is probably very little the Water Resources Commission can do to alleviate problems in Booth State Park. However, because recreational use of Antelope Creek is being affected, the Commission may wish to bring the situation to the attention of agencies and organizations that are more equipped to address such problems. The Commission may also direct staff to review any highway relocation or reconstruction plans carefully for ways to mitigate any injury caused by past construction or opportunities to prevent further damage.

Currently, the Parks Division is formulating a master plan for Booth State Park. This plan may offer the most direct means for addressing park problems. The Division may wish to consider the following in its planning process:

- The Parks Division might consider seeking highway funds for mitigation of any damage caused by road placement. This mitigation might include installation of log weirs, loose rock check dams, juniper riprap, or the planting of native vegetation to secure streambanks. Such a project might employ summer youth program employes or local conservation groups. Placement of interpretive signs indicating the purpose of project elements might provide a public information opportunity.

- With over 300 acres and only six picnic facilities, the park seems to be overlooked as a recreational resource. The Parks Division and Lake County might wish to study the feasibility of park improvements by seeking funds for water supply improvement and campsite development. The county might benefit from a high-profile, easy-access camping facility on a main thoroughfare. This may be especially true if the Quartz Mountain gold operation is developed to the level proposed and traffic increases accordingly.

SECTION 17
CHANDLER STATE PARK

A. ISSUE

Degraded stream conditions in Crooked Creek which affect Chandler State Park.

B. BACKGROUND

Chandler State Park is located 16 miles north of Lakeview on Highway 395. It covers 64 acres and is adjacent to Crooked Creek. The park features 12 unregulated campsites, six picnic units, drinking water facilities and restrooms. During the 1986-87 fiscal year, the park had a day use attendance of 67,380.

Crooked Creek is a small, perennial stream about 20 miles long that flows into the Chewaucan River near Lake Abert. Approximately 45 square miles of the drainage are above Chandler State Park. The park lies to the west of the creek and the highway. The creek in this area flows through a small canyon before it spills onto the Lake Abert valley.

The park offers limited fishing, a scenic forest corridor, and riparian vegetation which supports a number of bird species. Both birds and beavers can be observed by park visitors. Although Crooked Creek is not stocked for trout fishing, there is early season angling for native rainbow trout.

C. ISSUE DISCUSSION

The State Parks Division is concerned with maintenance of adequate water levels in Crooked Creek for angling and support of riparian vegetation. Within the park, the stream has a deeply cut channel with slumping banks. Currently, the stream condition limits fishing and wildlife viewing.

Highway 395 runs along Crooked Creek adjacent to the park. The Park Division has found that the quality of the riparian environment was damaged by stream channelization during road construction. In addition, cattle drives through the park may have some affect on the streambank condition. The effects of occasional use of the park by cattle is not necessarily negative. Because a large portion of the drainage is above the park, land use practices outside the park may also be having an effect.

D. MANAGEMENT STRATEGY ALTERNATIVES

The Water Resources Commission probably can do very little directly to effect a solution to Chandler State Park problems. Water Resources Department staff might be made available to consult with the State Parks Division on techniques for riparian restoration. Staff might also be directed to review any future highway plans for opportunities to mitigate past damages or avoid future harm to the riparian area along Crooked Creek.

Currently, the Parks Division is formulating a master plan for Chandler State Park. This plan may offer the most direct avenue for addressing the park's problems. The Division might consider providing for the following in its planning:

- Coordination between the Highway and Parks Division in future construction along Highway 395 near Chandler State Park. This might prevent future damage to riparian resources from channelization, stream re-routing or filling.

- Consultation with local riparian restoration experts and adjacent landowners to design stream and vegetation stabilization measures that would immediately benefit degraded areas. These might include juniper riprap, log-weir placement, loose rock check dams or the re-establishment of native vegetation.

- Formulation of a management plan to improve and protect Crooked Creek's riparian resources. The plan should investigate what, if any, impacts cattle drives might have on the park's stream condition. The plan should include an element providing for coordination with local ranchers to ensure that park resources are not damaged during cattle drives. In addition, opportunities for controlling any damage to the stream environment by park users should also be examined.

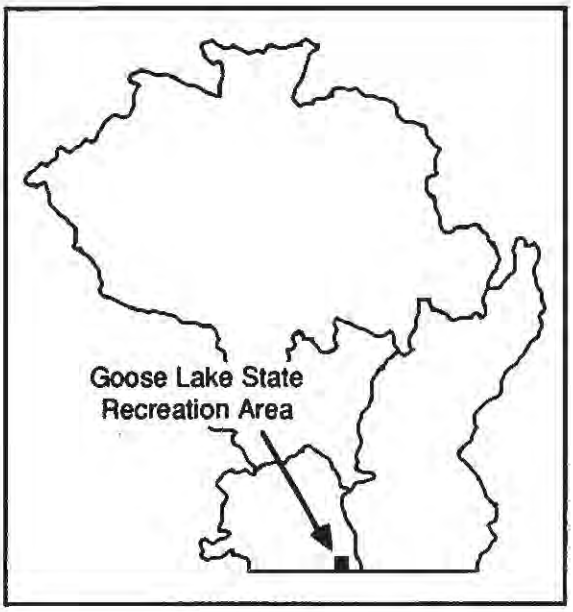
- Study of any opportunities to enlist the cooperation of local sporting or conservation groups in "adopting" the park for riparian improvements.

- Coordination with the Department of Fish and Wildlife in exploring opportunities for heightening awareness of park users regarding the function of riparian ecosystems.

SECTION 18
GOOSE LAKE STATE RECREATION AREA

A. ISSUE

Effects on the Goose Lake State Recreation Area caused by de-watering of Pine Creek in California.



B. BACKGROUND

Goose Lake State Recreation Area (SRA) is located 14 miles south of Lakeview on the California border. The SRA is on the east shore of Goose Lake. The SRA is a relatively small park with 48 improved campsites, 24 picnic units, drinking water, restrooms and a boat ramp. The SRA offers the only public access to Goose Lake in Oregon. In fiscal 1986-87, the SRA experienced over 66,000 visitor-days of use (day-use), and about 6,700 camper-nights.

Pine Creek is a small stream with most of its 15 square-mile drainage area in California. Pine Creek flows to the SRA, but half the flow is diverted within the park and re-routed around the eastern and northern boundaries. Currently, Pine Creek "shuts off" for several hours each day during summer because of upstream irrigation, mostly in California.

C. ISSUE DISCUSSION

Goose Lake SRA has a history of ecological disturbance. Pine Creek was channelized and re-routed within the park to allow construction of campgrounds. In addition, a large amount of fill was involved in campground development. Thus, it appears that wetlands and riparian areas in the park have deteriorated in the course of park development and use.

The Oregon State Parks Division places importance on maintaining or improving the riparian areas in the SRA. These riparian ecosystems are recreationally important to the park for wildlife watching. They are important to wildlife because riparian vegetation in surrounding areas is in much worse condition. The Division views maintenance of adequate streamflow in Pine Creek as an important factor influencing the condition of the riparian areas.

Water supplies for the SRA also are of concern. Wells in the park have had to be abandoned because of excessive sulfur or other mineral content. Currently, a well drilled two years ago is used for irrigation. An older well is used for drinking water. However, at times there is simply insufficient water supply for park uses. A dependable water supply is needed for drinking, restrooms and irrigation.

D. MANAGEMENT STRATEGY ALTERNATIVES

To the extent riparian area problems are influenced by water use in California, the Water Resources Commission has limited power to resolve resulting conflicts. The Commission might direct Water Resource Department staff to work with California authorities in identifying measures to lessen undesirable effects in Oregon from water use in California.

If riparian area problems are due to land use practices within the park, the Parks Division might explore changing them. For example, restoring flow to the original channel from the drainage ditch might counter-act effects of upstream diversions.

The water supply problem at the SRA is shared by other users in the area. These problems result mostly from natural conditions over which the Commission has no control. Solution to water supply problems probably has more to do with agency funding for deeper or additional wells than any other consideration.

GOOSE AND SUMMER LAKES DRAINAGE BASIN
OREGON

OREGON WATER RESOURCES DEPARTMENT
SALEM, OREGON
1988

MAP NO 13.6

POLYCONIC PROJECTION
NORTH AMERICAN DATUM 1927

MILES
1 0 1 2 3 4 5

DRAINAGE BASIN KEY

NORTH COAST 1
SANDY 3
HOOD 4
UMATILLA 7
GRANDE RONDE 8
WILLAMETTE 2
JOHN DAY 6
POWDER 9
MID COAST 18
DESCHUTES 5
MALHEUR 10
SOUTH COAST 17
UMPQUA 16
GOOSE & SUMMER LAKES 13
MALHEUR LAKE 12
OWYHEE 11
ROGUE 15
KLAMATH 14

LEGEND

INCORPORATED CITY
Population
1,000 — 10,000 ..... LAKEVIEW (D)
UNDER 1,000 ..... PAISLEY (D)
UNINCORPORATED COMMUNITY ..... Millican
PLACE NAME ..... Camp 9
FORMER COMMUNITY ..... (Oasis)
Includes place names of historical significance
ROADS: PAVED, GRAVEL, DIRT
AIRPORT: PUBLIC, PRIVATE, MILITARY
BOAT LANDING ..... LDG
PARK, CAMPGROUND, ETC. ..... PK CG RA R C
Includes State parks and waysides, Forest Service Camps,
BLM Camps, County and Municipal parks, Organizational Camps,
Resorts and Hunter Camps.
RANGER STATION, GUARD STATION, LOOKOUT ..... RS CS LO
ELEVATION IN FEET: LAND, WATER, ROAD 8141 6745 5704
PERENNIAL STREAM, LAKE
Lake status derived from U.S.G.S. 1:500,000 base map 1982
INTERMITTENT STREAM, LAKE
DRY LAKE
STREAM MILES (MILES ABOVE MOUTH) 15
CANAL OR DITCH ..... Conn Ditch
WATER PIPELINE, AQUEDUCT ..... Aqueduct
STREAM OR CANAL GAGE A3840
Active station with 10 years of record or more ..... ▲
Active station with less than 10 years of record ..... △
Inactive station with 10 years of record or more ..... ▼
Inactive station with less than 10 years of record ..... ▽
Inactive gaging stations with less than 5 years of record are not shown.
AGENCY: A = OWRD B = USGS C = OWRD/USGS
RESERVOIR, SMALL RESERVOIR ..... Res R
WATERHOLE ..... W
WATER TANK ..... WT
FALLS ..... Falls
SPRING ..... Prkby Spr
MARSH, MEADOW ..... Marsh Mdw
MINE
CAVE
NATIONAL FOREST
WILDLIFE REFUGE