DON ANDERSON

United States Department of Agriculture

Soil Conservation Service

Forest Service

Idaho Department of Water Resources

Idaho Department of Health and Welfare

Valley Soil Conservation District

Idaho Cooperative Irrigation Study

Lake Irrigation District

Cascade Res
Irrigation
flows

MAY 1988

IDAHO COOPERATIVE IRRIGATION STUDY

LAKE IRRIGATION DISTRICT

Prepared by

U. S. Department of Agriculture

Soil Conservation Service

Forest Service

and

Idaho Department of Water Resources

Idaho Department of Health and Welfare,

Division of Environmental Quality

in cooperation with

Valley Soil Conservation District

MAY 1988

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I. INTRODUCTION

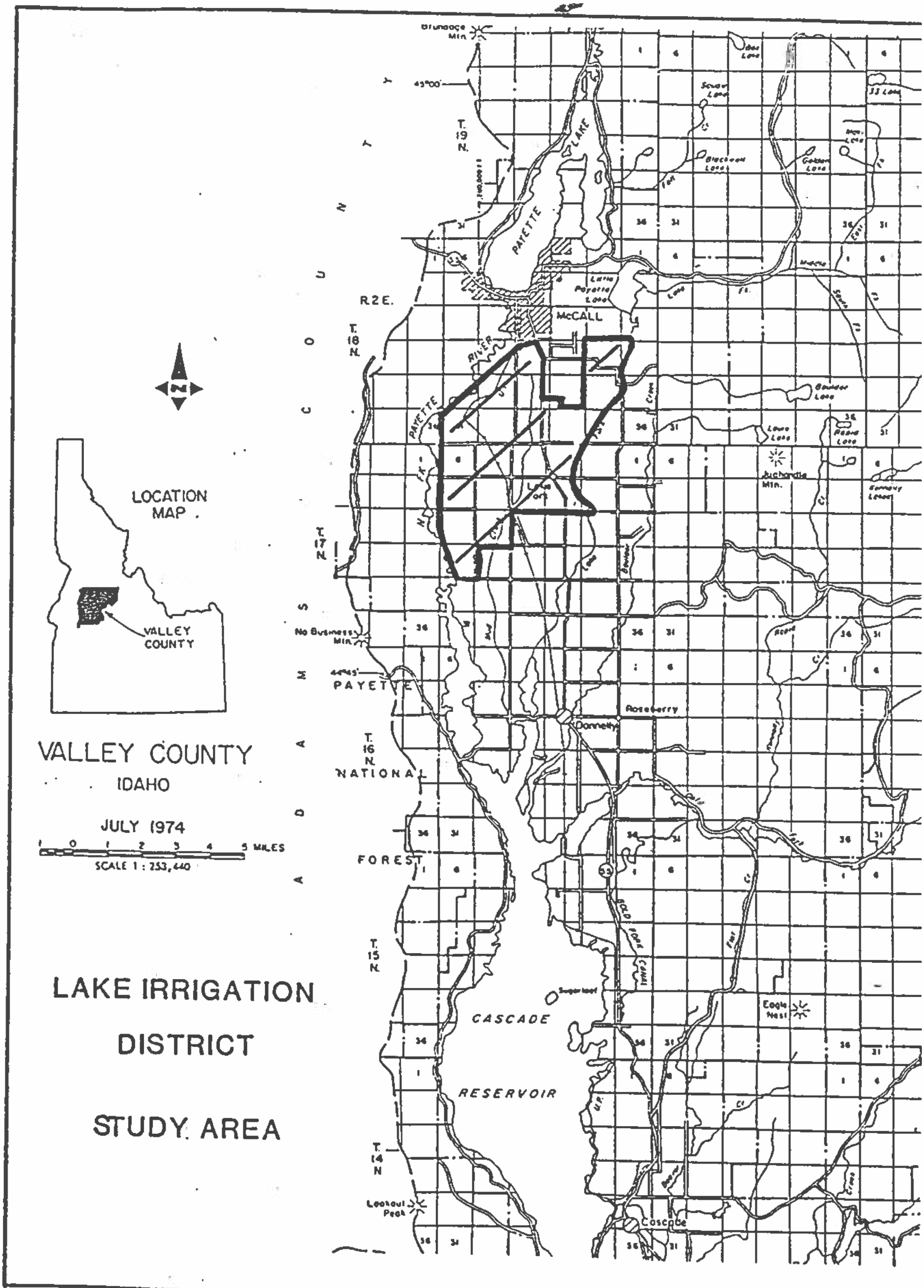
The Lake Irrigation District (LID) is located in the northwest portion of Valley County in west central Idaho. The irrigation water supply for the District comes from the snow pack in the Lake Fork Creek drainage. Runoff is stored in Little Payette Lake. Water is diverted from Lake Fork Creek and delivered through a system of canals and laterals to on-farm users.

In December 1985, the Valley Soil Conservation District received a request for technical assistance from the LID to evaluate the distribution and on-farm use of irrigation water. Their concerns included:

1) High water loss in delivery and on-farm systems.
2) Late season water shortage in low water years.
3) High maintenance costs due to erosion and sedimentation in the delivery system.
4) Irrigation return flows contributing to degraded water quality in Cascade Reservoir.
5) Mortality of game fish that entered the distribution system.

The LID was also interested in alternatives for replacing two major flumes.

A cooperative River Basin Study was selected as the best suited method to produce the resource evaluation. In light of previous studies by the Bureau of Reclamation and the Soil Conservation Service, additional irrigation water storage capacity of Little Payette Lake was not an issue to be considered.



LOCATION MAP
VALLEY COUNTY
VALLEY COUNTY
IDAHO
JULY 1974
0 1 2 3 4 5 MILES
SCALE 1 : 253,440
LAKE IRRIGATION
DISTRICT
STUDY AREA
PAYETTE LAKE
McCALL
PAYETTE RIVER
R2E.
T. 19 N.
T. 18 N.
T. 17 N.
T. 16 N.
T. 15 N.
T. 14 N.
No Business Mtn.
PAYETTE
NATIONAL
FOREST
Roseberry
Donnelly
CASCADE
RESERVOIR
Cascade
Lookout Peak
Eagle Nest
Jughandle Mtn.
Boulder Lake
ADAMS COUNTY

MAP A

The issue of water quality and its affects on the Cascade Reservoir led to the cooperative involvement of the Idaho Department of Health and Welfare, Division of Environmental Quality, who conducted the water quality monitoring.

II. STUDY AREA

A. General Description

Located two miles east of the City of McCall, Little Payette Lake is a at the center of the Lake Fork Watershed. The upper Lake Fork Creek drainage is characterized by steep mountainous forest lands. The water-collection area for the LID is located upstream from the Lake. The LID, located downstream, is on the flat to gently rolling plains and terraces.

The area of the upper watershed is about 36,500 acres. Vegetation is coniferous forests of pine, Douglas-fir, grand and subalpine fir and Engelman spruce with their associated understory of vegetation. Topography is steep to very steep mountains. Elevation ranges from 5,100 feet at Little Payette Lake to over 9,000 feet at Nick Peak. The soils are granitic and formed from the Idaho Batholith.

Climate in the upper watershed is typical for mountainous (high elevation) forest lands. The average annual precipitation is greater than 50 inches at the higher elevations. Most precipitation accumulates as snow where an average April depth of greater than 8 feet is common.

Land ownership within the upper watershed, is primarily Forest Service, administered by the Payette National Forest. The State of Idaho owns about 5,000 acres, most of which is located around Little Payette Lake.

Snowmelt and rainfall feed Lake Fork Creek which drains into Little Payette Lake. Peak runoff, according to U.S. Geological Survey streamflow records, usually occurs in late May to mid June.

The LID is located almost entirely within the Lake Fork and Mud Creek drainages of the North Fork Payette River watershed encompassing some 10,275 acres. The total area directly or indirectly affected by the LID is about 27,000 acres.

Lying between Lakefork and McCall, the LID is typical of large mountain valleys with level to strongly sloping lands on alluvial fans, terraces and plains dissected by drainageways and stream bottoms.

The soils of the valley area are the product of glacial erosion from the adjacent mountain granites. Mostly deep and well to moderately well drained, these soils have formed an alluvium and glacial outwash. Surface textures range from coarse sandy loam to clay loam.

The climate within the LID is typical for elevations of 4,800 to 5,000 feet in this region. The average annual precipitation at McCall is approximately 28 inches with about 6 inches occurring during the growing season.

The majority of precipitation occurs as winter snow with depths of 4 feet common. The average annual temperature at McCall is 40.4 degrees F. and the frost-free period is about 70 days.

The general economy of Valley County is based on agriculture, government services, mining, recreation and timber. The rural economy is based on agriculture with livestock being the predominant enterprise. Long Valley provides summer pastures for extensive cattle grazing. Some cattle are owned by local ranchers, but most of the forage is harvested by cattle brought in by nonresident ranchers on a rental basis. Rental values are determined by pounds gained during the grazing season. The major planted crop is oats which is sold for livestock feed. Seed potatoes grown are sold to southern Idaho and eastern Oregon markets. Being a virus and disease free area has promoted a high quality seed potato product.

B. Lake Irrigation District

The LID system was originally put into operation in 1927. Little Payette Lake, a natural lake, was raised to provide a total storage capacity of 23,850 acre feet. A diversion structure on Lake Fork Creek and about 36 miles of main canal and laterals provide irrigation water to about 35 water users on some 7,775 acres of cropland, pastureland and hayland. Water rights are also delivered to 12 subdivisions covering about 920 acres.

The gross consumptive use requirements for the crops grown within the LID are as follows:

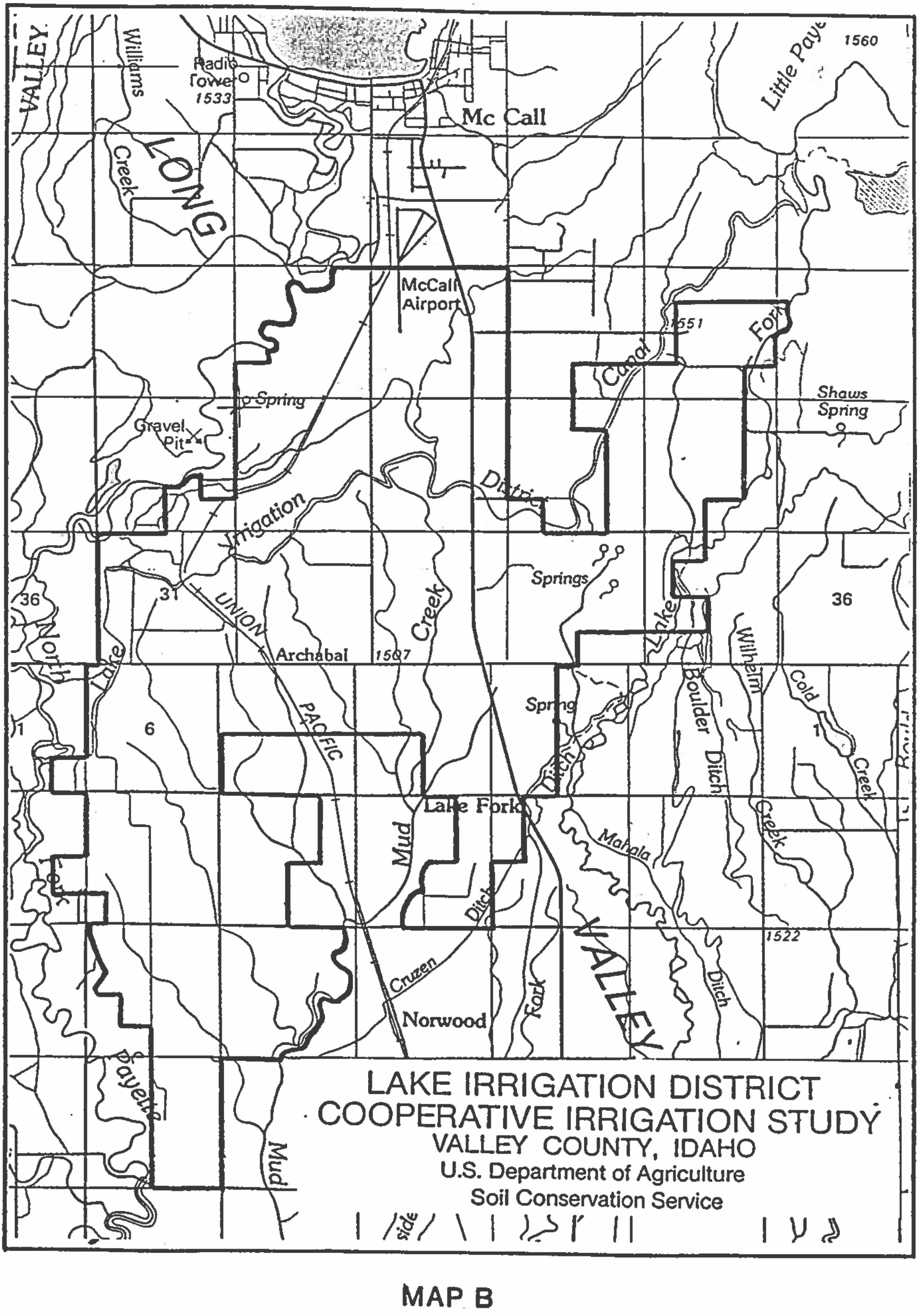
Grass Pasture	-	16.56 inches
Grass Hay	-	16.56 inches
Alfalfa	-	15.45 inches
Oats	-	13.36 inches
Seed Potatoes	-	11.28 inches

A crop water budget was developed using the acreage of crops grown. This water budget indicates that approximately 10,600 acre feet of water is needed to adequately irrigate the 7,775 irrigated acres within the LID. Calculated on an acreage basis, the water budget would equal 1.36 acre feet per acre.

LID records indicate that the average annual diversion totals approximately 34,000 acre feet. Water losses through their distribution system have been estimated to be 25 percent, leaving the distribution system efficiency at about 75 percent.

LID records also indicate that approximately 2.4 acre feet per acre are delivered to the users for on-farm use. The efficiency of on-farm water use is nearly impossible to calculate as irrigation is being influenced by several other factors. These factors include tailwater reuse, the effects of groundwater, and the use of flood right water.

Typically, over-irrigation occurs in the spring as flood right water is available for almost everyone's use. Stored water is also


LAKE IRRIGATION DISTRICT
COOPERATIVE IRRIGATION STUDY
VALLEY COUNTY, IDAHO
U.S. Department of Agriculture
Soil Conservation Service
Mc Call
McCall Airport
Radio Tower
1533
1560
Little Payette
Williams Creek
LONG VALLEY
Canal
1551
Fork
Shaws Spring
Spring
Gravel Pit
Irrigation
District
Springs
36
31
UNION PACIFIC
Archabal
1507
Creek
Lake
North
Wilhelm
Cold Creek
Boulder Ditch
Ditch
6
Lake Fork
Mud
Mahala
Creek
Ditch
Cruzen
Norwood
Fork
VALLEY
1522
Payette
Mud

MAP B

generally heavily used in the earlier part of the irrigation season causing late season shortages in approximately 2 out of every 10 years.

Land ownership within the LID is entirely private. The land use can be broken down as:

Cropland and Hayland	837 ac.
Irrigated Pastureland	6,937 ac.
Dry Pastureland	965 ac.
Subdivisions	958 ac.
Other Residential	427 ac.
Other Lands	151 ac.
TOTAL	**10,275 ac.**

The LID also serves an additional 167 acres of cropland located outside the District.

Most of the cropland and hayland is sprinkler irrigated. The pastureland is mostly surface irrigated, however, 1350 acres are sprinkler irrigated.

Annual crops grown are oats, barley, wheat and seed potatoes. Alfalfa is also grown in rotation.

Pastureland species composition is variable ranging from orchardgrass and clover, smooth brome and bluegrasses, to rushes, sedges and redtop on the wetter soils.

Ten different soil series have been mapped within the LID. Five soils make up the majority of the land in agricultural use. These soils can be grouped into two treatment units based upon their characteristics and management needs.

C. Treatment Unit 1

Treatment Unit 1 has sandy loam to silty clay loam soils that occur on nearly level plains or stream bottoms. They are poorly drained and management is limited by a seasonal high water table. Agriculture use is predominantly pasture. This treatment unit consists of some 1,800 acres with approximately 1,700 acres being irrigated.

These lands are used as unimproved and improved pastureland and hayland. Under good pasture and water management, this unit could yield 3 to 4 animal-unit-months (AUM's) of forage per acre through the growing season. (This is equivalent to approximately 1 cow per acre for a 4-month grazing period).

Pastures in this treatment unit are generally in poor condition, dominated by low value forage species of rushes, sedges and redtop. The naturally high water table is kept artificially high later in the season by over-irrigation and runoff from adjacent irrigated lands. This saturated soil condition is ideal for these low value forage species. Grazing is normally season long with light stocking rates. Under these conditions, cattle are able to exhibit selectivity resulting in uneven utilization. Grazing that occurs during irrigation results in a high amount of trampling damage to the forage as well as soil compaction.

Practices that can be used to control irrigation water and high water table conditions will also allow improvement in forage production. Applicable practices include land smoothing or land leveling, surface drainage system, subsurface drainage, irrigation system reorganization, water conveyance systems, and irrigation water management.

Practices that can be used to improve forage quality and production include pasture and hayland planting, pasture and hayland management, fertilization, fencing, and planned grazing systems.

D. Treatment Unit 2

Treatment Unit 2 has well-drained soils with deep rooting depths. Slopes range from 0 to 12 percent on irrigated lands. Agricultural uses are cropland, hayland and pastureland. The majority of the study area, approximately 8,640 acres, is in this treatment unit. Approximately 6,075 acres are being irrigated.

Expected yields, under a high level of management, include oats - 70 to 80 bushel per acre; alfalfa hay - 3 to 3.5 tons per acre; and grass hay - 2 to 2.5 tons per acre. Pasture production under high levels of management is 6 to 9 AUM's of forage per acre through the growing season. (This is equivalent to approximately 2 cows per acre for a 4-month grazing period.)

Almost all cropland is sprinkler irrigated. Some improvements can be made through better irrigation water application. The main problems center around maintaining soil fertility through a crop rotation and the application of commercial fertilizer. Maintaining proper soil pH also needs more attention to realize the maximum production potential of the soil.

It is estimated that 50 percent of the pastures in Treatment Unit 2 have species that are well adapted to the soil, climate and grazing use. The most common species are orchardgrass, timothy, smooth brome, and white clover. The remaining pastures are not occupied by species well adapted to the site on which they occur. The optimum productive potential is realized on few of the pastures. Average estimated production is 2 to 4 AUM's of forage for the season.

Few pastures receive commercial fertilizer nor are they being dragged or harrowed to scatter manure. Soil pH tends to be lower than desirable for optimal production.

Generally, grazing management is season long or a rotation system utilizing either two or three pastures. Stocking is light and cattle are able to exhibit maximum selectivity of forage resulting in extremely uneven use. Some plants are grazed to within an inch of the ground, while others are able to mature and set seed.

Over-irrigation is occurring along ditches and low-lying areas. Over-irrigation creates an environment in which low value forage species such as sedges and rushes are becoming dominant. Over-irrigation also allows nutrients to be carried off the pastures in the runoff or to be leached below the plant root zone through deep percolation. Grazing pastures during irrigation can cause soil compaction.

Pastures that do not receive adequate irrigation are dominated b more drought-resistant, low-value forage species.

The trend is generally downward in Treatment Unit 2. Uneven uti zation and irrigation are allowing the establishment of less desirable forage species. Existing irrigation systems and irrig tion water management practices contribute to the low production limiting the potential by either over or under-irrigation.

Practices that can be used to improve irrigation management inclu irrigation system reorganization, water conveyance system, land leveling, surface drainage system, and irrigation water managemen

Practices that could be used to improve crop or forage production include conservation cropping sequence, conservation ti lage, fertilization and liming, pasture and hayland planting, pisture an hayland management, and planned grazing system.

Table 1 gives a brief description of each soil and in which treat- ment unit it occurs. None of the soils have been identified as being prime or unique farmland.

TABLE 1 - SOIL DESCRIPTIONS

Treatment Unit	Soil	Surface Texture	Slope %	Depth 1/	Water Table
1	Roseberry (poorly drained)	SL	0-1	60"	1-2 ft.
1	Melton (hydric)	L	0-1	60"	1-2 ft.
1	Blackwell (hydric)	CL-SiCL	0-1	60"	.2-2.5 ft.
1	Roseberry/Melton Complex (poorly drained)	SL	0-1	60"	1-2 ft.
1	Cabarton (hydric)	SiCL	0-1	60"	.5-1.5 ft.
2	Archabal	L	0-20	60"	> 6 ft.
2	Gestrin	L	0-12	60"	3-4 ft.
2	McCall Complex	VCbSL	5-50	60"	> 6 ft.
2	Donnel	SL	0-12	60"	> 6 ft.
2	Duston	SL	2-4	60"	> 6 ft.
2	Kangas	CSL	0-2	60"	> 6 ft.

1/ The effective rooting depth is limited by the seasonal high water.

E. Environmental Setting

Water diverted from Lake Fork Creek is of high quality. Through its distribution and use, water from Lake Fork Creek is transferred into the Mud Creek drainage as irrigation return flows. Mud Creek originates as seeps and overland flows from the LID system. The ditches, drains and streams which comprise the drainage are water filled during the spring runoff and through the entire irrigation season.

The water quality and quantity of Mud Creek is significantly affected by irrigation and land use practices within its drainag area.

Lake Fork Creek and Mud Creek are tributaries to Cascade Reservoir. This large and relatively shallow water body is experienci increased deterioration of its water quality. The Idaho Departme of Fish and Game census shows the reservoir to be the number one fishery reservoir in Idaho in terms of fishing use. Lower water quality and resulting algal blooms are an issue which is gaining public attention.

Fish species within the LID include rainbow trout, brook trout, whitefish, squaw fish, large-scale sucker, sculpin and shiners. Spawning adults migrate from the Cascade Reservoir system to spawn in the upper reaches of Lake Fork Creek. Returning spawners and fr are at peril of drifting into various canal diversions including LID's as they move downstream. Once they are in the irrigation system, mortality is almost total.

Several ponds south of the McCall Airport runway are fed by LID waters. Some game fish that survive in the irrigation system drift into these ponds. Brown's Pond is stocked by the Idaho Department of Fish and Game four or five times annually and is a popular attraction for tourists and younger fishermen.

Many species of wildlife occur in the study area including mammals such as rodents, carnivores and big game species. Migrating ducks and geese pass through, and some common species nest within the area. Songbirds and common raptor species abound seasonally. No endangered species or species of concern are identified within the study area.

Wetlands occur throughout the study area, however, the majority occurs in Treatment Unit 1. This treatment unit consists of poorly drained soils, three of which are considered hydric. These soils are found in the drainageways and are influenced by irrigation return flows and a water table held up by excessive irrigation on adjacent lands. The Roseberry series is not considered a hydric soil, however, due to irrigation influence, types 1 and 2 wetlands can be found on this soil. Wetland types present include 1, 2, 3, 5, and 6. They are briefly described as follows:

Type 1: Temporarily flooded basins and low areas.

Type 2: Wet meadow - water table at or near the soil's surface during the growing season; hydric plants predominate.

Type 3: Seasonally flooded - adjacent to streams.

Type 5: Permanent pond (man-made).

Type 6: Shrub wetland - water table at or near the soil's surface during the growing season; vegetation is hydric with shrubs and trees.

The Food Security Act of 1985 contained a provision called "Swampbuster." This provision restricts landusers from receiving certain USDA Program benefits if they have converted wetlands for the production of an agriculture commodity following the passage of this Act.

III. RESOURCE PROBLEMS

The following resource problems have been identified regarding water delivery, on-farm use and return flows.

A. High water losses in the delivery system. Soil types that are porous allow excessive seepage and subsequent water loss from the system.

B. On-farm delivery losses are excessive and irrigation efficiencies low. The rolling terrain necessitates small irregular fields and requires a maze of on-farm delivery ditches, resulting in high on-farm distribution losses. Subirrigation methods, often used on well-drained soils, result in very low irrigation efficiencies.

C. In-canal erosion and the resulting sedimentation causes high operation and maintenance costs. Some erosion is inherent due to the design of the canal system. Other areas of erosion are the result of livestock access on canal banks. On-farm operation and maintenance costs on pumped sprinkler systems can be excessive due to nozzle and pump wear and sediment basin cleanout.

D. Water management and delivery through the system is not efficient. Many existing canal structures have exceeded their service capability; one flume in particular is in danger of failure at any time.

E. Lack of control over fish entering the LID system. This wastes a natural resource that could be an asset in Lake Fork Creek and downstream in Cascade Reservoir.

F. Water Quality in Cascade Reservoir is becoming excessively enriched with nutrients. Irrigation return flows from LID lands into Mud Creek are a factor in water quality within the Reservoir's watershed.

IV. SUMMARY OF WATER QUALITY MONITORING REPORT

Water quality monitoring was conducted by the Idaho Department of Health and Welfare, Division of Environmental Quality, on agricultural lands and tributaries draining to Cascade Reservoir during 1986. Stations located above and below the cropland and pastureland were monitored for nutrients, sediment and bacteria. Tributary stations were monitored for nutrients, bacteria, flow, COD, dissolved oxygen and pH. Samples were collected every two weeks during the irrigation season.

The irrigation return flows from the surface irrigated cropland and pastureland exceeded 0.05 mg/L total phosphorus, the level which results in accelerated eutrophication in lakes and reservoirs, 100% of the time. The irrigation return water from the sprinkler irrigated cropland exceeded this level on about 50% of the survey dates.

The surface irrigated cropland had the most severe water quality impacts between the upper and lower sampling points. Nutrients and sediment were dramatically increased below the surface irrigated cropland. These results are consistent with data obtained from similar studies.

The least impact to water quality was detected below sprinkler irrigated cropland. The levels of nitrogen, sediment, and turbidity did not change significantly below sprinkler irrigated cropland. There was an increase in the level of dissolved orthophosphate below the sprinkler irrigated cropland, but the increase was 30 times less than the increase detected below surface irrigated cropland.

The water quality monitoring results from the surface irrigated pastureland showed an average increase of over 600% in dissolved orthophosphate and an increase of 180% in total nitrogen. The increases in the dissolved orthophosphate concentrations and the total nitrogen levels below the surface irrigated pastureland are attributed to the leaching effect of this type of irrigation practice on the soluble nutrients. Total phosphorus levels did not show a significant increase below the flooded pastureland, which is correlated to a lack of accelerated sediment runoff. There was not a significant increase in turbidity or total suspended solids below the irrigated pastureland. Although there was an increase in nutrients below the surface irrigated pastureland, this was not correlated with the presence or absence of grazing animals.

Mud Creek exceeded the nuisance phosphorus level of 0.05 mg/L on 33 percent of the survey dates.

The average concentration of total phosphorus in surface waters in the Cascade Reservoir Watershed, as determined by this survey, was near 0.10 mg/L, or between five and ten times the amount of an uncontaminated watershed. The cumulative impacts of these tributaries on the Reservoir are resulting in nutrient levels exceeding the recommended criteria for avoiding accelerated eutrophication.

V. FORMULATION OF ALTERNATIVES

The alternatives were formulated by evaluating the problems identified by the sponsors. It was determined that alternatives should be proposed which would stand by themselves or could be combined with other alternatives. Because of this, any given alternative will not have an impact on all of the identified concerns.

Alternative 1 - Flume Replacement

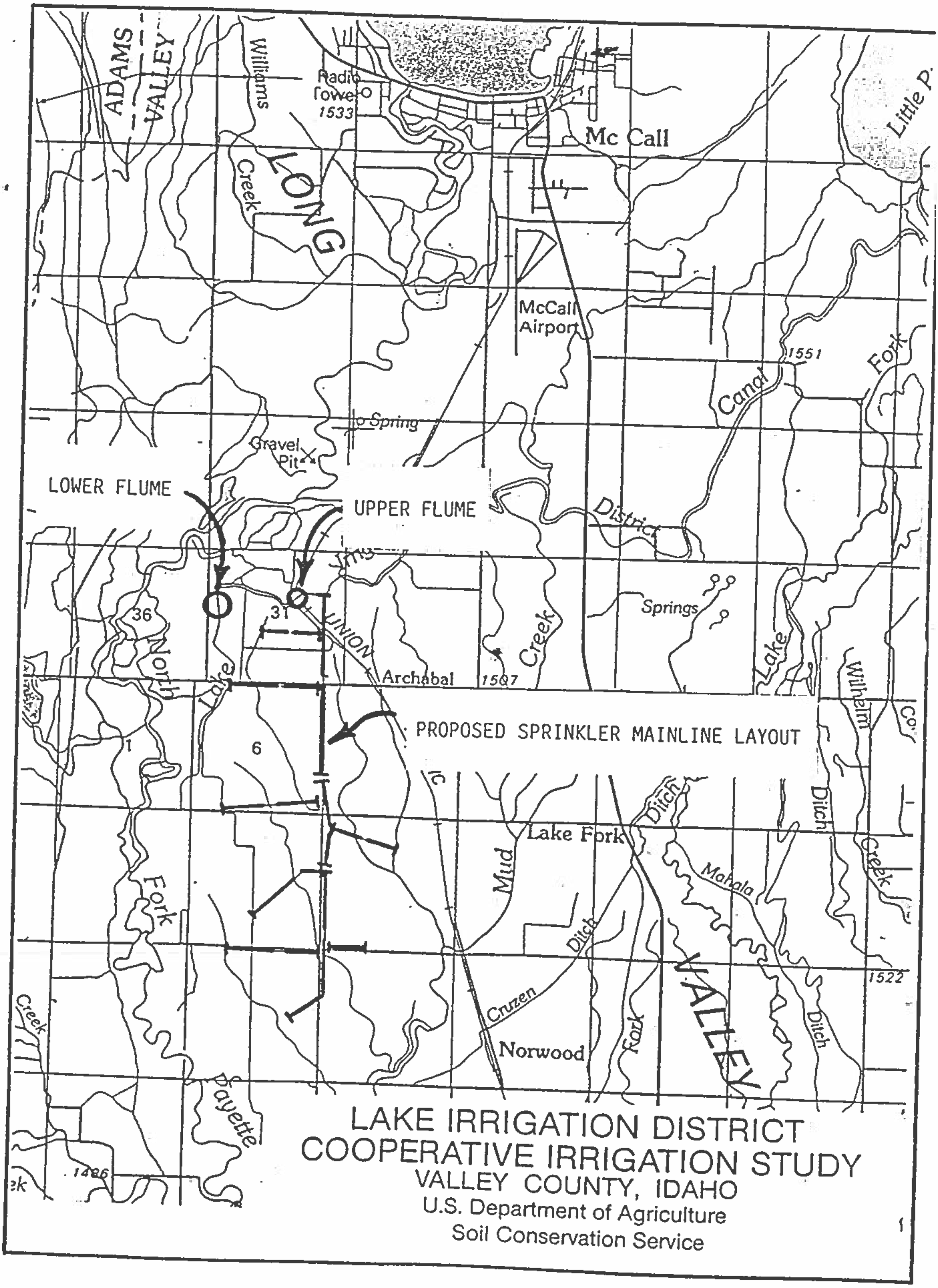
The existing system has two flumes which are constructed of metal and supported by timber trestles. Both of the flumes have deteriorated over the years, and one of them could fail at any time. This alternative presents methods to replace the flumes with pipes or an earthfill with an open channel (Refer to Map C).

Alternative 2 - Canal Sealing

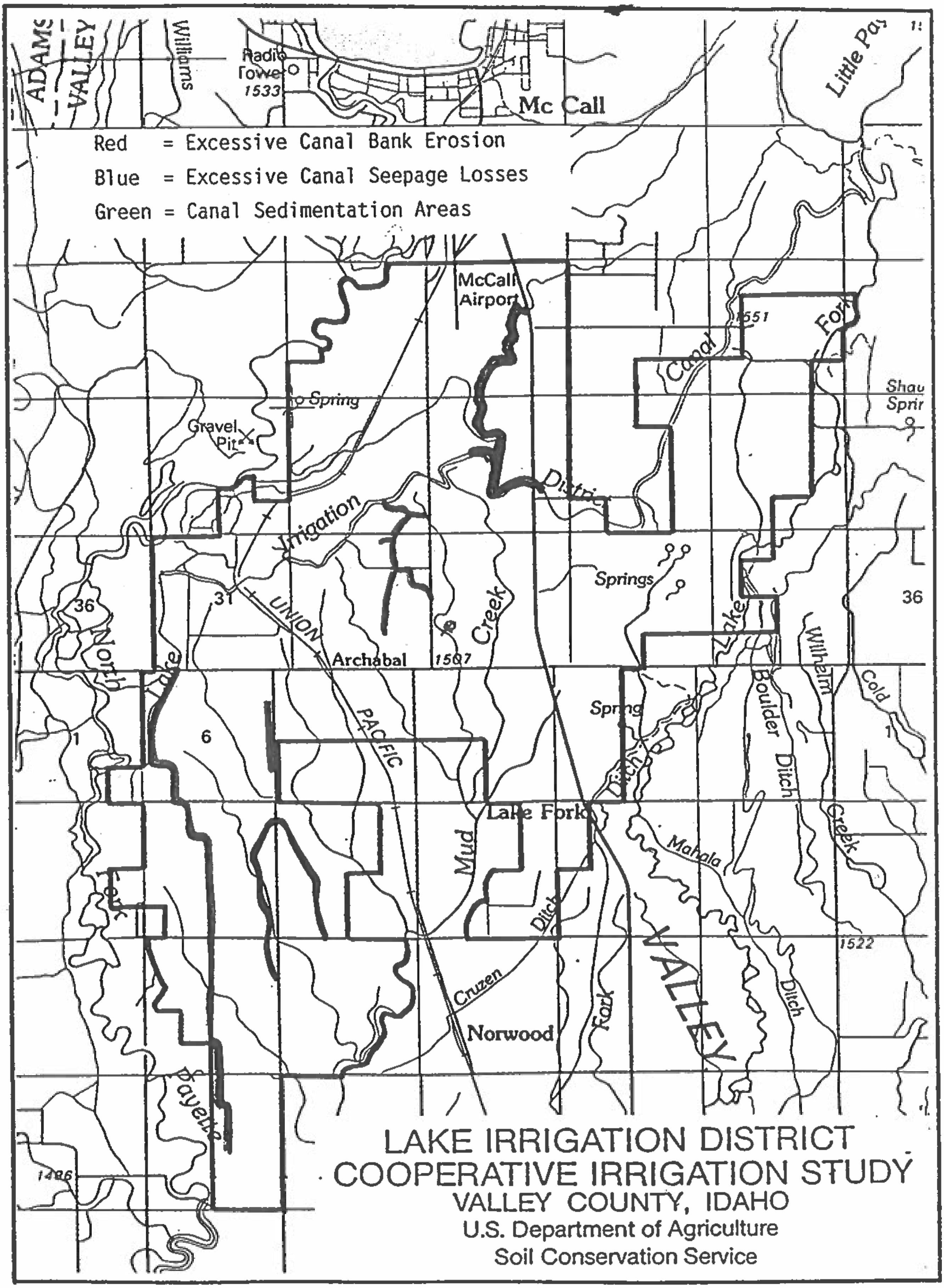
Flow measurements were taken in the Lake Irrigation Canal and in the Stringer Ditch. These measurements were used to identify reaches of the canal with excessive seepage.

Two reaches were identified (Refer to Map D), including 8,800 feet in the Stringer Ditch and 2,900 feet in the Lake Irrigation Canal. This

1/ Lake Irrigation District Study and Cascade Reservoir Tributary Assessment, Patricia Klahr, December 1987, Idaho Department of Health and Welfare, Division of Environmental Quality.


ADAMS
VALLEY
Williams
Creek
LONG
Radio
Tower
1533
Mc Call
McCall
Airport
Spring
Gravel
Pit
1551
Canal
Fork
LOWER FLUME
UPPER FLUME
District
Springs
36
31
6
1
UNION
Archabal
1507
North
Lake
Creek
Lake
Wilhelm
PROPOSED SPRINKLER MAINLINE LAYOUT
Ditch
Lake Fork
Mud
Mahala
Creek
Fork
Ditch
Cruzen
Norwood
VALLEY
Fork
1522
Ditch
Creek
Payette
1486
Little P
LAKE IRRIGATION DISTRICT
COOPERATIVE IRRIGATION STUDY
VALLEY COUNTY, IDAHO
U.S. Department of Agriculture
Soil Conservation Service

MAP C


ADAMS
VALLEY
Williams
Radio Tower
1533
Mc Call
Little Pa
Red = Excessive Canal Bank Erosion
Blue = Excessive Canal Seepage Losses
Green = Canal Sedimentation Areas
McCall Airport
1551
Canal
Fork
Shau Sprir
Spring
Gravel Pit
Irrigation
District
Springs
36
31
UNION
Archabal
1507
Creek
Lake
North
Lake
Wilhelm
Cold
Boulder
Ditch
Spring
Ditch
1
6
PACIFIC
Lake Fork
Mud
Mahala
Creek
Fork
Ditch
1522
Cruzen
Norwood
Fork
VALLEY
Ditch
Payette
1486
LAKE IRRIGATION DISTRICT
COOPERATIVE IRRIGATION STUDY
VALLEY COUNTY, IDAHO
U.S. Department of Agriculture
Soil Conservation Service

MAP D

alternative evaluates sealing these reaches with bentonite or a chemical sealant.

Alternative 3 - Canal Erosion Reduction

An inventory of the canal systems was made to identify reaches of the canal which have excessive bank erosion (Refer to Map D.) Three reaches were identified including 6,400 feet on the E Ditch, 2,600 feet on the J Ditch, and 12,200 feet on the Lake Irrigaiton Canal. This alternative presents methods to stop the canal erosion with combinations of drop structures and fencing.

Alternative 4 - Structure Replacement

An inventory was made of all the structures owned by the LID. These structures were identified by size, material, and expected remaining life. This alternative consists of replacing the structures which are in poor condition in accordance with a planned replacement schedule.

Alternative 5 - On-Farm System Improvements

Although the LID does not have any control over the on-farm systems within the District, several problems exist on the existing systems. This alternative addresses potential changes in the on-farm delivery of irrigation water and the need for improved irrigation water management.

Alternative 6 - Sprinkler System

During the inventory of the system, it was noted that both of the flumes needing replacement and two of the three reaches of excessive channel erosion are on the west side of the system. There is adequate fall from the north end of the system to the south end to provide head for a gravity sprinkler system, although some of the on-farm systems would have to be boosted.

This alternative evaluates the potential of a gravity pressured sprinkler mainline to replace the west part of the existing system (Refer to Map C).

Alternative 7 - Fish Screening Structure

Water from Lake Fork Creek is diverted into the Lake Irrigation Canal. There is currently no screen on the diversion. The Idaho Department of Fish and Game is concerned about the large number of trout fry, as well as larger fish, that enter the canal and cannot get back to Cascade Reservoir. This alternative presents preliminary cost data for a screening structure.

VI. EVALUATION OF ALTERNATIVES

Alternative 1 - Flume Replacement

Two existing flumes that will need to be replaced were analyzed.

The lower flume in the system is a 480 foot long, 5 feet in diameter, semicircular pipe supported on a wood trestle. It was installed in 1951 and has a maximum estimated remaining life of 15 years. This reach is too steep to replace the flume with an earthfill, as velocities in a channel on the fill would be erosive. A 28 inch diameter welded steel pipe inverted siphon could be used. The existing inlet and outlet structures could be used with some modifications. The estimated cost is $17,300.

The upper flume was built over a railroad grade in 1938. It consists of half-round sheets of metal supported by a wood trestle. It is approximately 120 feet long. This flume is in poor condition and could fail at any time. Two options were evaluated at this site.

The first option is to replace the flume and trestle with an earth fill. An open channel would be constructed over the fill. Due to high velocities in the channel, it would be lined with an impervious material such as a butyl rubber liner. The top width of the fill was estimated at 50 feet to allow for a 16-foot wide access road on each side of the channel. The estimated cost of this option is $17,200.

The second option which was analyzed was a steel pipe inverted siphon. A 42 inch diameter pipe would be required. The estimated cost of this option would be $13,100.

A third option was to use two steel pipes side by side as an inverted siphon. Two 30 inch diameter pipes would be required. The estimated cost of this alternative is $14,300. Annual cost and benefits are shown on Table 4.

Alternative 2 - Canal Sealing

Two reaches of canals were identified as having excessive water losses. Two methods of sealing the canal were evaluated at each site.

The first reach identified was 8,800 feet of the Stringer Ditch. Lining the canal with a good grade of bentonite would cost approximately $16,000. Sealing this canal reach with a chemical soil sealant would cost approximately $8,900. The potential water savings is estimated to be 805 acre feet per year.

The second reach identified was 2,900 feet of the Lake Irrigation Canal near the Stringer Ditch. Lining this reach with bentonite would cost approximately $8,700. Sealing this reach of canal with a chemical soil sealant would cost approximately $8,500. The potential water savings by sealing this reach of canal is estimated to be 1,837 acre feet per year. Before these reaches of canal are sealed, the impacts to wet areas and ponds immediately below the Stringer Ditch should be evaluated. Annual cost and benefits are shown on Table 4.

Alternative 3 - Canal Erosion Reduction

Three reaches of canal were identified during the inventory as having active and excessive erosion. At least part of the problem is caused by cattle trampling the banks. Because of this, fencing is included in all three reaches as part of the solution to the erosion problem.

Two of the three reaches have some erosion in the channel bottom. Wood and/or rock grade control structures were evaluated at these sites for erosion control. The reach which has erosion primarily due to the bank sloughing is 6,400 feet on the E Ditch. The two reaches with both bank sloughing and channel erosion amount to 2,600 feet on the J Ditch and 12,200 feet on the Lake Irrigation Canal. The following chart displays the item, quantity, and estimated cost for each component evaluated. Annual cost and benefits are shown on Table 4.

Canal	Item	Quantity	Cost
E Ditch	Fencing	12,800 feet	$ 5,100
J Ditch	Fencing	5,200 feet	$ 2,100
J Ditch	Wood Drop Structures	12 structures	$ 6,400
J Ditch	Rock Drop Structures	12 structures	$ 7,500
Lake Irrig. Canal	Fencing	24,400 feet	$13,400
Lake Irrig. Canal	Wood Drop Structures	12 structures	$15,400
Lake Irrig. Canal	Rock Drop Structures	12 structures	$15,900

Alternative 4 - Structure Replacement

An inventory of the existing structures owned by the Lake Irrigation District totalled 282, including 183 wood structures and 99 gated outlet structures. In estimating the expected remaining life of each structure, about 145 structures will have to be replaced within the next five years. Based on material costs plus time and labor costs provided by the LID, cost estimates for replacing each type of structure were made. An average wood structure costs $300, and an average gated outlet structure costs $520.

A replacement schedule was developed for all structures using 0, 5, 10, 15, 20, 25 and 40 years as target replacement time frames. The total cost for replacing the structures is based on the present value of future replacement costs. The present value cost of structure replacement is $57,125. Annual cost and benefits are shown on Table 4.

Alternative 5 - On-Farm System Improvements

Improvements to the on-farm systems were evaluated for each of the two treatment units.

One option was evaluated for Treatment Unit 1. This is primarily the area which has an average slope of 0 to 1 percent with a water table at about 18 inches. The existing system would be reorganized. Structural practices which would be used include: land smoothing or leveling on 475 acres; new diversions, turnouts, and measuring structures on 475 acres; new earth ditches on 375 acres; border irrigation systems on 200 acres; and gated pipe systems on 100 acres. The total cost of applying these structural practices is estimated to be $105,125.

Management practices would also be a part of this alternative. These practices include pasture renovation, pasture and hayland planting, proper pasture management, fertilization, and irrigation water management. The annual cost of pasture management has been considered to be $17.00 per acre. This management cost includes annual fertilization, management and renovation on an 10-year interval.

Installation of this option on Treatment Unit 1 would increase pasture yields from 3.0 AUM's per acre to 4.5 AUM's per acre. Grass hay yields would increase from 1.5 tons per acre to 2.0 tons per acre. Based on prices of $12 per AUM and $50 per ton of grass hay, the benefits of applying this option are shown in Table 2.

Treatment Unit 2 consists of areas which have a slope range of 0 to 12 percent and soils that are deep and well drained. Two options were evaluated for this treatment unit. The first of these was to reorganize the existing systems. Structural practices which would be used include: land leveling on 1,000 acres; land smoothing on 2,000 acres; new diversions, turnouts and measuring structures on 3,000 acres; new earth ditches on 2,600 acres; conveyance pipelines on 2,000 acres; gated pipelines on 300 acres; border irrigation systems on 200 acres; and concrete ditches on 100 acres. The total cost of applying these structural practices is estimated to be $591,600.

The second option evaluated on Treatment Unit 2 was to convert 4,465 acres to sprinkler irrigation systems. The cost of converting this acreage to sprinkler systems is estimated to be $1,786,000.

Both of the options for Treatment Unit 2 would include management practices such as pasture and hayland management, pasture and hayland planting, fertilization, and irrigation water management.

Benefits for installing these options were estimated using the following increases in crop production: pasture production will increase from 4.0 AUM's per acre to 6.0 AUM's per acre; alfalfa hay yield will go from 2.5 tons per acre to 3.0 tons per acre; and grain yield will increase from 60 bushels per acre to 75 bushels per acre. Hay and pasture prices used were the same as for Treatment Unit 1. The price used for oats was $2.25 per bushel. A summary of the annual costs and benefits for all options is shown in Table 2.

TABLE 2 - SUMMARY OF ANNUAL COSTS AND BENEFITS FOR ALTERNATIVE 5

Treatment Unit	Option Number	Total Annual Benefit	Total Annual Cost 1/	Benefit:Cost Ratio
1	1	$31,790	$38,381	0.83:1
2	1	150,315	148,189	1.01:1
2	2	150,315	255,721	0.59:1

1/ Project costs include the cost of structural practices and management practices. Annual costs are based on an interest rate of 8 7/8% over a 50 year period.

The Food Security Act of 1985 contained a provision called "Swampbuster." This provision restricts land users from receiving certain USDA Program benefits if they have converted wetlands for the production of an agricul ture commodity following the passage of this Act. It is recommended that, prior to any installation of on-farm practices mentioned in this study, land users contact the Soil Conservation Service to see if their fields may be impacted by this Swampbuster provision. Implementation of such practices as land smoothing, land leveling and subsurface drainage could permanently affect the conversion of a classified wetland.

Alternative 6 - Sprinkler System

The west part of the existing system could be replaced with a gravity sprinkler system. A mainline could be sized to carry water for three different conditions. These conditions are:

A. ACTUAL WATER RIGHTS

The water rights of one miners inch per acre will be delivered by the mainline to all the irrigated areas downstream of the point where the mainline would come out of the canal. This includes an area on the south end of the system which would not be converted to sprinkler systems.

B. WEIGHTED CONSUMPTIVE USE OR WATER RIGHT

The mainline will deliver 5.5 gallons per minute (gpm) per acre (0.61 miners inch per acre). This amount is the actual weighted consumptive use of the crops grown in the area to be irrigated by sprinkler systems. All surface irrigated land, including the area on the south end of the system, would be delivered 9 gpm per acre (one miners inch per acre).

C. WEIGHTED CONSUMPTIVE USE, SPRINKLED LAND

The mainline will deliver 5.5 gpm per acre to all land that will be sprinkler irrigated. It will not carry water to any of the areas which will remain in surface irrigation.

The evaluation of a mainline for condition A showed that pipe ranging from 36 inches to 6 inches diameter would be required. This would serve 2,723 acres. For estimating costs, steel pipe was used for all pipe sizes over 24 inches diameter. PVC pipe was used for all sizes up to and including 24 inches. The total estimated cost for this condition is $1,202,000.

A mainline to serve condition B would require pipe ranging from 32 inches diameter to 6 inches diameter. This mainline would provide 9 gpm per acre to 858 acres and 5.5 gpm per acre to 1,865 acres. The total estimated cost of the system for this condition would be $1,041,000.

A mainline for condition C to deliver 5.5 gpm per acre to 1,865 acres requires pipe ranging from 28 inches in diameter to 6 inches. The total cost of this system would be $777,000.

The cost estimates for each condition include pipe materials, pipe handling, appurtenances, trenching, backfill, outlet structures, and an inlet structure.

Installation of a mainline to fit either condition A or B would have the following benefits:

1. The two flumes which need replacing would be eliminated. Replacement costs for the flumes would be $30,400 or an annual cost of $2,737.

2. Thirty-seven wood structures and 16 gated outlet structures would be eliminated. The present value of the replacement costs for these structures would be $12,162 or an annual cost of $1,095.
3. The J Ditch, a portion of the Lake Irrigation Canal, and portions of two small delivery ditches would be eliminated. The total length of canal which would be eliminated is 59,300 feet. The current annual cost to the District to maintain these reaches of canal is $1,956.
4. Pumping costs for sprinkler irrigation would be reduced. It is estimated that pumping cost reductions would equal $8,708 per year. Some booster pumps would be required in the system to achieve adequate sprinkler operation.

5. Significant water savings would be achieved by installing a mainline. The amount of water which could be saved was estimated for each condition. The dollar benefit from each condition is based on a water cost of $7.50 per acre foot. The water savings for condition A is estimated to be 3,010 acre feet with an annual benefit of $22,575. The water savings for condition B would be 4,880 acre feet with a benefit of $36,600. The water savings for condition C would be 3,150 acre feet with a benefit of $23,625.

Installation of a mainline to fit condition C would not have the first three benefits shown. The total annual cost and benefits for each condition are summarized in Table 4.

Alternative 7 - Fish Screening Structure

Requirements for a fish screening structure at the diversion from Lake Fork Creek into the Lake Irrigation Canal were discussed with the Idaho Department of Fish and Game. A cost estimate was developed based upon data supplied by a firm that manufactures and installs this type of screening structure. Various options for mechanical, solar or water-powered models are available. The total estimated cost for a screening machine, a D.C. drive and power system, a control panel and installation is $50,000 annual cost and benefits are shown on Table 4.

VII. SUMMARY

The individual alternatives which have been defined and evaluated in this report do not address all of the sponsor's identified problems. However, combinations of alternatives can be selected which could address most, if not all, of the problems. Table 3 displays qualitatively how each alternative would impact the various problems. The significance of the impacts are rated as either high (H), medium (M), low (L), or (-) no impact.

TABLE 3 - IMPACT AND EFFECT ON IDENTIFIED PROBLEMS

Alternative Number	High Water Loss in System	Late Season Water Shortage	High Maintenance Costs Due to Erosion & Sedimentation	Degraded Water Quality (Return Flows)	Mortality of Game Fish
1	M	L	-	-	-
2	H	H	-	-	-
3	-	-	H	M	-
4	L	-	-	-	-
5	L	H	-	H	-
6	H	H	H	H	-
7	-	-	-	-	H

The economic assessment of the flume replacement (Alternative 1), can only be compared to what production would be without irrigation. This replacement is a cost of operation.

The annual benefit of reducing seepage losses (Alternative 2), is assessed at the minimum value placed on an acre foot of water. The operation and maintenance value is $7.50 per acre foot for water saved. Presumably, any water saved would be valued at this minimum rate if the LID made this saved water available for sale. It has been estimated that this alternative would save some 2,642 acre feet of water. This saved water could also benefit the late season water supply.

Treating erosion areas within the canal system (Alternative 3), has an annual benefit amounting to the reduced maintenance to the LID. The benefits for reduced on-farm operation and maintenance costs for sprinkler nozzle wear, pump maintenance and the cleanout cost of settling basins, were not evaluated within this alternative.

The structure replacement alternative (Alternative 4), has annual benefits generally in terms of improved water delivery efficiency and ease of operation for the LID personnel.

Alternative 5 considers both structural and improved management practices necessary to improve the productiveness of the land. Estimate benefits almost equal the estimated cost of improvements. Water savings, as a result of improved irrigation water management practices, were not estimated. However, if the on-farm surface system efficiency was increased from 25 percent to 30 percent, it is estimated that approximately 4,000 acre feet o water could be saved for late season irrigation use. This alternative wou also be very favorable towards improving the quality of irrigation runoff a return flows entering Cascade Reservoir.

Alternative 6 maximizes total water savings for the LID and water quality improvement through decreased runoff in the watershed. The water saved would become available for other uses including late season irrigation use. Water saved from the three options considered range from 3,010 to 4,880 acr feet. Water savings along with other management practices, similar to thos outlined in Alternative 5, could result in improved crop and forage yields. Increased crop and forage yields were not evaluated for this alternative. This alternative also appears to be very favorable toward improving the quality of irrigation return flows entering Cascade Reservoir.

Alternative 7 has no direct annual benefits to the LID. The fishery resou in Lake Fork Creek and the downstream stocking to Cascade Reservoir is a valuable resource to the general public and would reduce other more expens stocking methods now found necessary to use. This alternative would eliminate the present loss of game fish to the LID system.

The following table summarizes the costs and benefits for installing each alternative. In cases where more than one option was evaluated to solve a problem, only the least costly option is shown in the table. The table do not show operation and maintenance, engineering or administration costs.

TABLE 4 - COMPARISON OF EVALUATED ALTERNATIVES

Alternative	Total Cost	Annual Cost 1/	Annual Benefit	Water Saved Ac. Ft.
1	$30,400	$2,737	$ --	--
2	17,400	1,567	19,815 2/	2,642
3	42,400	3,817	1,956 3/	--
4	57,125	--	--	--
5	--	186,570	182,105 4/	--
6A	1,202,000	108,216	37,071 5/	3,010
6B	1,041,000	93,721	51,096 5/	4,880
6C	777,000	69,953	32,333 5/	3,150
7	50,000	4,501	--	--

1/ Annual costs amortized for 50 years at 8 7/8% interest.
2/ Value of 2,642 acre feet of water at maintenance and operation cost of $7.50 per acre foot.
3/ Based upon annual maintenance and operation costs.
4/ These benefits do not include water savings from improved irrigation water management.
5/ These benefits do not reflect any changes in production due to better water management or increased water supply in water short years.

VIII. FUNDING SOURCES

Federal cost-sharing programs can provide financial assistance for projects which have an overall positive net benefit. The following funding sources are available.

Conventional Bank Loans

Conventional loans through private lending institutions are available for conservation improvements. Funding for implementation of all the structural and land treatment measures of the preferred alternative could be accomplished by this method.

Farmers Home Administration (FmHA) Loan Program

FmHA has two basic loan programs available for the implementation of land and water development measures. Irrigation and drainage loans are avail-

available for legal entities (irrigation companies, nonprofit corporations etc.) to finance the rehabilitation of delivery system improvements. Individual landowners could obtain soil and water conservation loans to implement their on-farm system improvements.

Soil Conservation Service (SCS) Assistance to Soil Conservation Districts Public Law 46

Under the authorities of this program, SCS can help individuals and groups plan and apply needed soil and water conservation practices on private land. This technical assistance could be used to help implement improvements to the delivery system, on-farm distribution systems and irrigation water management.

Agricultural Stabilization and Conservation Service (ASCS) Cost-share Program:

The Agricultural Conservation Program (ACP) provides funds for cost-sharin with individuals and groups of landowners for the installation of conservation practices. The ACP cost-sharing program could provide funds for both on-farm improvements through their regular cost-share program as well as for group projects through a pooling agreement on their ACP specia cost-share program.

Soil Conservation Service PL-566 Program

The Small Watersheds Program provides technical and financial assistance t local sponsoring organizations in planning and carrying out programs for t development, use and conservation of soil and water resources of a small watershed area. This could include cost-sharing and technical assistance for both structural system improvements and on-farm land treatment measure

Idaho Department of Water Resources (IDWR) Loan Programs

The IDWR loan programs authorize the State to make loans and/or grants to legal entities of government for water resources projects which are in the public interest. Funding may be available from the following three programs:

1. Water Management Account (grants and/or loans).
2. Revolving Development Account (loans).
3. Bonding Programs

Bureau of Reclamation (BOR) Small Reclamation Projects Act (PL-84-984, as amended)

The BOR is authorized under this act to make loans to legal entities for development or rehabilitation of irrigation and/or drainage systems. This type of loan could be utilized for financing structural improvement measures.