Cross-Cut Diversion - This site is located at the Henrys Fork diversion dam into the Cross-cut Canal (Sec. 14, T. 8 N., R. 41 E.), seven miles northeast of St. Anthony. A power plant could use a ten-foot drop at the diversion dam located just below the mouth of the Falls River. The estimated annual generation is 11,000 MWH or an average generation of 1,200 KW. By using two miles of the canal a total gross head of about 35 feet appears to be available. This design would require a three-fourths mile penstock.

Enterprise Hydroelectric - This site is located at the Enterprise Canal siphon crossing of the Teton River, about three miles northeast of Newdale. Annual generation is estimated at 5,500 MWH, a 600 KW average. Water from the Enterprise Canal would drop 100 feet. The water would be diverted from the Falls River, about five miles above its mouth, to the Enterprise Canal. The power plant could use only excess irrigation water so power generation would be higher in April or August than in June, a month of high irrigation use. The canal could also be used during the nonirrigation season except during maintenance periods or when icing problems cause difficulty.

Partridge - As identified in Waterpower Resources of Idaho, water would be diverted to a conduit at the confluence of Warm River and Partridge Creek in Sec. 20, T. 11 N., R. 44 E and moved three miles to a powerhouse at Sec. 33, T. 11 N., R. 44 E. The 250 feet of head would be developed between elevations 6,050 and 5,800. This project could develop an average 3,000 KW of energy.

Boone Creek - See "Surface Water Shortage Sites" under "Water Supply."

Lower Ashton - This project has been identified in a short reconnaissance report by the Corps of Engineers. A 25-foot drop through a structure on the Henrys Fork would average 3,000 KW or about 22,000 MWH of energy. A reservoir 2.4 miles long would be created immediately below Ashton Reservoir. The project was estimated at 55 mills per KWH with an interest rate of 12 percent.

Victor - This project would use water from Trail, Moose and Game Creeks located southeast of the town of Victor in Teton County. Waterpower Resources of Idaho suggests an average of 2,000 KW can be generated through 400 feet of drop at this site. This area now has a gravity sprinkler system using this water during the irrigation season. The need to maintain sprinkler pressure cuts in half the amount of potential generation during the irrigation season. There are two pressure reducing stations in this irrigation system. The pressure reducing stations would have some generating capacity other than during peak flow times. Nonirrigation season use of this system generally would only be possible for about 250 feet of elevation drop in the steel pipe portion of the system that takes water from Game Creek. The asbestos pipe used in other parts of this system is better used only for warm weather operations. New facilities would be needed to use Trail Creek water during the nonirrigation season.

Canyon Creek - See "Spring Creek" under "Surface Water Storage Sites" in the "Water Supply" section.

Fish Creek - Water could be diverted by canal at the 5,800 feet elevation level on Fish Creek. This would give 440 feet of head down to the 5,360 elevation level on Warm River. To make a project economical, water also would need to be collected from Robinson, Snow and Rock creeks at the 5,800 feet elevation level. Two one-mile tunnels would significantly shorten canal routes, however, five miles of canal would still be needed. The average annual generation is estimated at 2,000 KW with a power plant nameplate rating of 4,000 KW.

Buffalo River Hydro - See "Surface Water Shortage Sites" under "Water Supply."

Upper Badger - See "Surface Water Storage Sites" under "Water Supply."

Coffee Pot Rapids - About 45 feet of river drop within a distance of one-half mile on the Henrys Fork at Coffee Pot Rapids could be developed. The average annual energy available is estimated at 1,000 KW. Flows vary from about 250 cfs to near 600 cfs although average flows appear to be about 350 cfs.

St. Anthony Canal - At the Henrys Fork diversion dam, located about three miles east of St. Anthony, water could be taken into the St. Anthony canal. On the north side of the river, the water would move about one mile then drop 13-15 feet back to the river. Potential generation would be about 5,500 MWH from 800 KW generators.

Marysville Drop - A drop of nearly 66 feet in the upper end of the Marysville Canal, Sec. 36, T. 9 N., R. 43 E., is a potential hydropower site. The project could be used only during the irrigation season. The Falls River (FERC #9885) project has prior water rights during the nonirrigation season. This project could generate an average of 200 KW of electricity with a reported 40 cfs of water. This site is listed in the Tudor report.

Yellowstone Hydro - This potential 4,500 KW power plant is located on the Falls Rivers above the earlier described Falls River project. The 28,000 MWH estimated average annual generation would provide an average 3,200 KW. The diversion point would be the existing Yellowstone Canal diversion from the Falls River in Sec. 23, T. 9 N., R. 45 E., two miles upstream of the National Forest boundary. The powerhouse would be four miles downstream where the estimated drop from the canal to the river is 110 feet. This powerhouse location is just upstream of the Marysville Canal and the Falls River hydroelectric project. As with the Falls River project, enlargement of the canal would allow for power plant operation most of the year.

Other Projects - There are other potential hydropower sites in the basin. For example, the Henrys Fork drops 100 feet from Warm River to Ashton Reservoir, 60 feet between Ashton Reservoir and the Falls River, 90 feet between Falls River and St. Anthony, and 140 feet from St. Anthony to the Teton River, South Branch. The Falls River drops 350 feet between the Falls Hydroelectric Project powerhouse at the Reclamation Road river crossing and the Falls River mouth.

Recommended Action

1. The Idaho Water Resource Board makes no recommendation for specific project development at this time.
2. The Water Resource Board's policy concerning hydropower is: that energy conservation and efficiency improvements are the most desirable methods to provide additional power, that new hydropower resources be developed at existing structures whenever feasible, and that new projects should be carefully evaluated to insure that the benefits to the state outweigh any negative consequences.
3. Where state protected river designations prohibit new hydropower development, the Water Board will consider petitions to amend the comprehensive state water plan on a case-by-case basis. Where the benefits outweigh any negative consequences the Board will initiate the amendment process and seek public input.

Sources

Barclay, Donald E. *Electric Power Water Needs*. Idaho Power Company for the Idaho Water Resource Board. Planning Report No. 6. Boise: 1970.

Federal Energy Regulatory Commission various project orders.

Heitz, Leroy, F., Calvin C. Warnick, and John S. Gladwell. *Idaho Hydroelectric Potential, Appendix V: Upper Snake River Basins.* Idaho Water Resources Research Institute. Moscow, Idaho: August, 1980.

Hoyt, W.G. *Water Utilization in the Snake River Basin.* U.S. Department of Interior, Geological Survey, Water-Supply Paper 657. Washington, D.C.: 1935.

Tudor Engineering Company. *Western States Inventory of Low-Head Hydroelectric Sites, Volume 1:* San Francisco, 1980, p. 59 and others.

Sterling, Rick. *Development of PURPA Qualifying Facilities in Idaho.* Idaho Department of Water Resources. 1990.

U.S. Corps of Engineers, Walla Walla District, *Low-Head Hydro Power Reconnaissance Report, Snake River at Clear Lakes (Rm 594), near Buhl, Idaho and Henrys Fork River near Ashton, Idaho.* December 1979.

Utah Power and Light Company. *FERC Form No. 1: Annual Report of Electric Utilities, Licenses and other (Class A and Class B.* Salt Lake City: December 31, 1981.

Whitehead, R.L. *Water Resources of the Upper Henrys Fork Basin in Eastern Idaho.* U.S. Geological Survey in cooperation with the Idaho Department of Water Resources. IDWR Water Information Bulletin No. 46. Boise: May, 1948.

Flood Control

Within the Henrys Fork Basin there are two areas which exhibit significant flood problems -- the Lower Teton River (both the north branch and the south branch) and the Lower Henrys Fork below Ashton Reservoir. The highest flood peaks are caused by winter rain and low elevation snowmelt over frozen ground, but the more common flooding is from springtime snowmelt which may be augmented by rain.

Only a relatively small portion of the total land area is susceptible to flooding. However, many of the flood-prone areas are located in the more intensively settled areas. Generally, these areas are narrow strips along the stream and include good farmland, rural settlements and urban strips. Floods seldom cause loss of life but often result in damage to land and buildings, highways, railroads and irrigation facilities.

Large floods on the Teton River have an average reoccurrence interval of every four years, although, recently, they have been more frequent. General Teton River inundation occurs with a discharge over 4000 cubic feet per second (cfs) which is exceeded about one year in four. Normal bank full capacity appears to be 2000 cfs, which is exceeded almost every year. Strengthening of the

partial flood control levees as a part of the emergency follow-up work after the Teton Dam flood, has increased river capacity in urban and other selected areas. However, these levees do not provide complete protection, and in many areas there are no levees. On the Teton River the particularly hazardous period is early spring when ice jams are common. Ice jamming is accentuated by natural stream obstructions and poorly designed bridges and irrigation weirs.

Instantaneous flow near the town of Teton from a periodic flood of a 10 year, 50 year, 100 year and 500 year interval are respectively: 4,800 cfs, 9,000 cfs, 13,000 cfs, and 21,000 cfs. The highest flow of record is 11,000 cfs on February 12, 1962 except for the Teton Dam failure (1,700,000 cfs). Most years the maximum flow occurs in May or June. Estimates are that 60 percent of the flow moves through the South Branch Teton River and 40 percent of the flow moves through the North Branch.

Given the relative low flows that cause inundation outside the stream channel (2000 cfs) there is a high frequency of flooding. The 100 year floodway area is 11,000 acres for 23 miles of stream along two branches. At a purchase value of $1,500 per acre, including buildings, the total property value would be just over $16,000,000.

There are nine bridges over the Teton River with bridge beams so low that there is a damming of water for a 100 year flood (ACE, 1977; FEMA, 1990). Most of the bridges are county-owned. The worst three bridges have such low beams even a ten year flood appears to cause a water rise of four to five feet. This damming raises the river level at these constrictions and accentuates the flooding of surrounding land. The constriction in turn allows for some riverbed filling, generally on the upstream side of the bridges.

Even bridges repaired after the 1976 Teton Dam failure are a problem. The bridges may not have been raised sufficiently to clear a 100 year flood or even a 50 year flood. Flood control from the Teton Dam project was assumed when a state-owned bridge, built just prior to the Teton Dam flood, was designed. The flood left the bridge but washed out the approach road which was replaced. Another state bridge was built with lower flood flow criteria than those used by the Corps of Engineers. This bridge shows a gouging of the riverbed which suggests constriction at the bridge, with a resulting upstream water level rise and adjacent flooding.

A bridge design with closely spaced piers can similarly contribute to flooding because they collect brush and/or ice blocks. Winter ice-jam floods are more common at higher elevations. Railroad bridges are examples of the closely spaced pier design. The design of some water diversion structures also may need to be reviewed to make sure there is not unnecessary damming or brush collection during flood conditions.

A review of the river profile shows several county bridges have riverbed gouging under the bridge, or a significant drop in the riverbed just downstream from the bridge. Both are a major indication of constriction which results in an increase in upstream flooding. The following table lists the Teton River bridges, the distance the beams are under water in a 100 year flood, and the amount of water level rise from the downstream to the upstream side of the bridge. All county bridges are in Madison County except as noted. On the Lower Henrys Fork there is one state bridge (Highway 33), one Madison County bridge, one Fremont County bridge and one railroad bridge for which flood constriction flow data is not available. Further study is needed to determine flood levels on the lower Henrys Fork.

Proper bridge design will pass a 50-year flood with two feet of clearance below the beams, and pier spacing and river channel width limit water level rise to one foot. A 100 year flood generally increases the river level rise an additional one foot over the 50 year flood so the 50-year flood design criteria will generally pass a 100-year flood. (A 500-year flood generally raises the water level only an additional foot over the 100-year flood.)

Table 47. Teton River Bridges

Bridge Location	Depth Bottom of Bridge Under 100 Year Flood	Water Level Rise Downstream to Upstream Side of Bridge in 100 Year Flood
South Branch (Fork) Teton River		
County Bridge - Two miles west of Rexburg then north ¼ mile	5½ feet	2½ feet
County Bridge - Secondary system one mile west of Rexburg then 3/4 mile north - Hibbard-Egin Road	4 feet	3 feet
U.S. 20 - Two bridges	¾ foot	zero
Union Pacific Railroad - North side of Rexburg	½ foot	2 feet (very close pier spacing)
State-U.S. 33 - North edge of Rexburg - Current data	1 foot	1½ feet
County - Sugar City road two miles east of Rexburg then ¼ mile north	4 feet	1½ feet
County - Secondary system - Moody Road - Two miles north then two miles west of Rexburg	2½ feet	6 feet
County - Three miles north then two miles west of Rexburg	6 feet	6 feet
State - Idaho 33 - Current data	3 feet	5 feet
Fremont County - Teton Road - Secondary system-One-half mile north of Teton	½ foot	1 foot
North Branch (Fork) Teton River		
County - Secondary system - One Mile west then three miles north of Rexburg	zero	minor
County - Secondary system - Salem- Parker Road - Kilgore Road - Four miles north of Rexburg	zero	minor
County - One mile east then one mile north of Salem	zero	zero
U.S. 20 - Two bridges	zero	zero
Union Pacific Railroad	zero	minor (very close pier spacing)
County - One-half mile north, one mile east and three-fourths mile north of Sugar City	zero	minor
Madison and Fremont Counties - One mile west of Teton then one mile north	4 feet	2½ feet
Fremont County - Teton Road - Secondary system one-half mile north of Teton	½ foot	minor
Falls River - Fremont Count - one and one-half miles north of Chester	2 feet	zero
(Elevation data not available on other Falls River Bridges)		

A flood relief channel known as the Newdale Diversion has been proposed for the Teton River. In Sec. 15, T. 7 N., R. 41 E., a diversion structure would be placed in the river at the mouth of the canyon, just above the Newdale Road crossing three miles north of Newdale. A 10-foot dam would divert a major portion of Teton flood water to the Henrys Fork in the vicinity of St. Anthony. Further study would determine the best alignment of an approximate four-mile canal. Accompanying levees may be needed at the Henrys Fork junction with the Teton River. Drilling done as part of a preliminary study for a 23,000 acre-foot reservoir at this site, indicates heavy water losses through the south bank. Water loss will be much less without a storage structure.

For the Henrys Fork the flood hazard starts just below Ashton Reservoir, north of St. Anthony. The critical area appears to start further downstream at a point located four miles below St. Anthony. Similar to the Teton River, ice-jam flooding associated with spring snowmelt appears to be the major problem. At the Henrys Fork, Rexburg gage the bank-full river capacity is about 4500 cfs (generally exceeded two years out of three), while the largest flood of record is 16,400 cfs. A U.S. Corps of Engineers Special Flood Hazard Report is not available for this lower Henrys Fork reach so the periodic flood level peaks are not known.

There is minor control of the Henrys Fork at Island Park Reservoir and at Henrys Lake. These reservoirs provide only limited flood control since they are in the upper third of the drainage basin.

In addition, flood control operation criteria for the reservoirs provides a very low amount of dual flood control-irrigation space, 23,000 acre-feet at Island Park and none at Henrys Lake Reservoir.

Recommended Action

1. A reconnaissance flood control study on the Lower Henrys Fork below St. Anthony is needed. The study should include a USBR/IDWR review of the feasibility of more dual flood control-irrigation space being provided in upstream reservoirs and exchanged for irrigation space in main-stem Snake River reservoirs.
2. Encourage the Corps of Engineers to undertake flood control studies on the Lower Teton River. A first phase would be to determine the current channel capacity.
3. Bridges within the basin should be reconstructed to current design standards. Low bridges can cause water level increases during flood conditions. Such construction would reduce any possible liability for flood damages.
4. Any new public or private water storage reservoir, including off-stream reservoirs, should have some flood control space combined with the other uses of the reservoir.

Sources

Columbia-North Pacific Region Comprehensive Framework Study of Water and Related Lands, Appendix VII, Flood Control, Pacific Northwest River Basin Commission, June 1971.

Flood Insurance Study. Fremont County, Idaho Unincorporated Areas, Federal Emergency Management Agency, Preliminary, March, 1990.

Flood Insurance Study. Madison County, Idaho and Incorporated Areas, Federal Emergency Management Agency, Preliminary, January 1, 1990.

Special Flood Hazard Information, Teton Rivers Vicinity of Rexburg and Sugar City, Idaho, U.S. Corps of Engineers, December 1976 and Supplement February 1977.

Water Quality

In general, the groundwater quality of the Henrys Fork basin appears to be good in both the highlands and the agricultural valleys. The exception might be warm water areas where fluoride may be high. In the Ashton area and near the mouth of the basin, the bicarbonate and calcium levels that govern water hardness are higher than in most other areas of the basin. A concern with groundwater in the basin is bacterial levels. In a 1979 study of the Eastern Snake River Basin, 20 percent of tested wells exceeded total coliform standards, and 11 percent exceeded fecal coliform standards. Coliform bacteria are bacteria that live in the intestinal tract of living organisms. Fecal coliform bacteria live in the intestinal tract of warm-blooded animals. Not all fecal coliform are disease causing bacteria, however, they are an indicator of the possible presence of disease causing bacteria and viruses. More stringent control of well construction since 1979 may have reduced the problem. (See "General Water Quality" in the Appendix.)

Much of the highland groundwater eventually becomes surface water at springs or streams. Surface water in the basin, most of the time, is of quite good quality. In the upper basin plateau areas the few exceptions relate to a marginally high fluoride condition in Big Spring Creek, the Buffalo River, Warm River, and the Falls River. There also are some summer periods when there is such a significant inflow of nutrients (phosphorous and nitrogen) that there is considerable aquatic

growth in surface waters. Much of this nutrient inflow appears to be natural, although septic tank effluent may be contributing a significant amount. Further study is needed to distinguish the contribution from each source. The aquatic growth reduces the clarity of the water, but provides a food base for fish. In the lower reaches of the basin irrigation return flow, as well as early season spring runoff from tilled agricultural land, adds nutrients, sediment, and related organic matter to the streams.

General Contaminants

The two water-born chemicals that allow for algae growth in water are the plant nutrients phosphorous and nitrogen. Phosphorous is common in several rock types in the upper Henrys Fork basin. The phosphorous is available as a dissolved mineral but the larger source is sediment with attached phosphorous. With so much phosphorous available in basin rock, a major goal is to keep down soil erosion. In water having a total phosphorous concentration greater than 0.025 mg/l, algal densities are high enough to significantly reduce water clarity.

Nitrogen is usually present in the soil, particularly in biological matter. Some nitrogen may enter the basin from precipitation, chiefly from snow (see R. G. Wetzel, Limnology, W. B. Saunders Co., 1975). Excessive concentrations of nitrate and ammonia (NH_3) in water generally result from leaching of organic and inorganic material. Nitrate does not enter into ion-exchange reactions so it tends to stay in solution and does not attach itself to soil particles. This can result in relatively high concentrations in groundwater, particularly near agricultural areas where fertilizers may contribute to nitrate concentrations unless special slow release types of nitrogen fertilizers are used. Ammonia does break down but attaches to soil particles. Biologic organisms further breakdown ammonia to nitrites and then to nitrates, both nonattaching.

Since both phosphorus and nitrogen are essential to normal plant growth, dense undesirable algae "blooms" occur in water bodies that receive excessive amounts of these nutrients. Warm water temperatures (over 68°F) also contribute to heavier algae growth. The Henrys Fork is nitrogen limited and therefore more responsive to changes in nitrogen levels.

Excessive algae growth occurs in shallow, wide, unshaded river reaches during the summer. Some algae growth is needed to provide food for macroinvertebrates. Excessive algae growth, however, detracts from visual enjoyment of the water, and sudden algae decomposition depletes dissolved oxygen. Dissolved oxygen is an indicator of the ability of a stream to sustain fish populations. The State of Idaho has set water quality standards for cold water fisheries. Dissolved oxygen levels must be above 6 mg/l, and the maximum daily average temperature is limited to 19°C (66°F). For salmonid spawning dissolved oxygen must be above 6 mg/l or exceed 90 percent saturation, whichever is greater, with a maximum daily average water temperature below 9°C (48°F).

Related to the negative impact of excessive algae growth in water is the impact of turbidity. Turbidity is a cloudiness of the water caused by suspended solids or sediments. As with algae growth, turbidity detracts from the visual enjoyment of the water body. Suspended solids greatly reduce the amount of sunlight needed to produce the instream vegetative matter used by macroinvertebrates. Consequently, there is a reduction of lower-level organisms and a reduction in available fish, especially of the salmonid family. Suspended materials settle out on the stream bottom in areas of reduced flows such as pools, backwaters, and in-between gravels. This causes fish spawning redds to be covered by sediments, which in turn suffocates the developing fry. Additionally, the sediments fill in gravel areas on the stream bottom which are hiding and reproduction areas for macroinvertebrates. This directly reduces the numbers and kinds of food salmonids

feed upon. Other minor impacts caused by sediments include gill abrasion, increased stress, and lack of feeding caused by an inability to see the target food.

Idaho water quality requirements contain three different standards for fecal coliform levels in both primary contact and secondary contact waters. A geometric mean limits actual count to 200 colonies per 100 milliliter (ml) sample for secondary contact recreation such as water skiing and 50/100 ml for primary contact recreation such as swimming. In addition, primary contact waters are not to have actual counts more than 500 colonies per 100 ml at any one time, nor can they contain 200 colonies per 100 ml in more than 10 percent of the samples taken over a 30-day period. Secondary contact waters are not to have actual counts more than 800 colonies per 100 ml at any time, and no more than 400 colonies per 100 ml in 10 percent of the samples taken over a 30-day period.

Water used for domestic water supplies have standards generally relating to man-caused contaminants. Most of these are positively-charged cations. These cations and the anions cyanide, fluoride, and nitrate with their maximum allowable concentrations in mg/l are:

Arsenic	0.05	Barium	1.00
Cadmium	0.01	Chromium	0.05
Cyanide	0.20	Fluoride	1.40 - 2.40
Lead	0.05	Mercury	0.002
Nitrate	10.00	Selenium	0.01
Silver	0.05		

Similarly, standards in mg/l have been established for the following pesticides in open water bodies:

Endrin	0.0002	Lindane	0.004
Methoxychlor	0.10	Toxaphene	0.005
Trihalomethane	0.10	2,4-D	0.10
2,4,5-TP silvex	0.01		

As part of a regulations program, about 50 additional pesticides can be monitored in drinking water after it leaves a treatment plant or moves into a distribution system. Regulatory control is not currently set by specific maximum allowable concentrations but by general control criteria. In addition, groundwater used for public drinking supplies shall not exceed the following standards in mg/l. If these standards are exceeded, new water delivery systems must treat the water to reduce these chemicals:

Copper	1.00	Chloride	250.00
Hydrogen sulfide	0.05	Iron	0.30
Manganese	0.05	Sulfate	250.00
Zinc	5.00	Alkyl benzene sulfonate (ABS - plastic)	0.50
Phenols	0.0001		
Benzene	0.005	Vinyl chloride	0.002
Carbon tetrachloride	0.005		
Total dissolved solids	500		
Temperature	80°F		
Color	15 units		
Odor	3 units		
General bacteria	500/ml		

A maximum ground-water source turbidity standard, regardless of treatment, has been established at five nephelometric turbidity units. New requirements on coliform bacteria have been adopted by the Federal Government. The new requirements state the ground-water source shall contain no coliform bacteria. Treatment will be required on any public drinking water source having coliform contamination.

Maximum contamination levels have also been established for specific radioactive chemicals and radioactive particles in drinking water systems. On the Island Park plateau, outside the Caldera area, and along the Big Hole Mountains, and in other areas over felsic (rhyolite) material, the potential

exists for the occurrence of radium-226 in groundwater. Only community water systems are now sampled for this hazard. Community systems in general are not located in these areas. Individual wells located in areas with rhyolitic bedrock should be tested for radium.

Nonpoint Source Pollution

Both surface water and groundwater quality control has centered on controlling "point source" discharges, such as from a municipality or an industrial plant. Nonpoint source pollution comes from many sources and is carried into the stream by runoff.Primary nonpoint source impacts to water quality in the Henrys Fork watershed are from agricultural activities including irrigated crop production, pastureland, rangeland and minimal amounts of non-irrigated crop production. There are additional impacts from forest practices, on-site wastewater systems, channelization, riparian vegetation removal, streambank modification and flow modification (IDHW, 1988). Cold water biota and salmonid spawning are only partially supported in many of the tributaries to the Henrys Fork and Henrys Lake Outlet. In the Henrys Fork below St. Anthony primary and secondary contact recreation are potentially at risk. The primary pollutants are sediment from agricultural activities and hydrologic/habitat modifications, nutrients and bacteria from agricultural activities, and wastewater systems.

The Teton River watershed, above its divergence, is impacted by irrigated and non-irrigated crop production, rangeland activities, channelization, dam construction and riparian vegetation removal. Tributaries to the Teton are impacted by pastureland, flow modification, riparian vegetation removal and streambank modification. From Trail Creek to Highway 33, the Teton River and its tributaries, only partially support cold water biota and salmonid spawning. From Bitch Creek to the Teton damsite cold water biota and salmonid spawning are either not supported or only partially supported. Primary and secondary contact recreation are potentially at risk. The primary pollutant in the Teton River is sediment from agricultural impacts and hydrologic modification. Additional problems are thermal modification and flow alteration.

Agricultural impacts from irrigated crop production, pastureland and rangeland are the primary sources of nonpoint source pollution after the Teton River diverges into its North and South Forks. Non-irrigated crop production and some animal holding areas contribute additional nonpoint source impacts, primarily from channelization of streams. The primary pollutants from nonpoint source activities are nutrients, sediment and bacteria from agriculture. Cold water biota and salmonid spawning are only partially supported in this river segment. Primary and secondary contact recreation are potentially at risk.

Shallow aquifers in the lower Henrys Fork and in the Teton Valley are of special concern because of the considerable use of the aquifer for drinking water, the shallow depth to water, the application of significant amounts of chemicals and the relatively porous nature of the subsoil.

A number of new regulations have been adopted on nonpoint source discharges. Among those which have an impact on the Henrys Basin are the Forest Practices Act (Title 38, Chapter 13, Idaho Code), and the Idaho Surface Mining Act (Title 47, Chapter 14, Idaho Code).

Specific Water Bodies

Island Park Reservoir - In 1981 water quality was impaired somewhat by algal blooms and occasional high fecal coliform bacteria counts. Algae blooms provide conditions which aggravate ammonia toxicity; excessive algae decomposition depletes dissolved oxygen below the stratified zone.

Island Park Reservoir has a relatively shallow depth (generally less than 50 feet) with little stratification because of wind action during the ice-free months.

Algae blooms in Island Park Reservoir are stimulated in the summer by a natural occurring phosphorus concentration of 0.04 mg/l. A USBR study suggests, septic tank drainage from recreation areas does not contribute significantly to reservoir phosphorous loading (Zimmer, 1981). The dissolved orthophosphorous (non-biological in origin) concentration was exceptionally high (0.60 mg/l) in springs emerging from both developed and undeveloped shorelines. Ground-water flows and bank storage thus appear to play a dominant role in the phosphorous dynamics of the reservoir.

The occasional high counts of fecal coliform bacteria may originate with livestock operations or inadequately treated sewage at recreation facilities in the area. The installation of adequate sewage treatment facilities will hopefully solve this problem.

Henrys Lake - The lake is less than 30 feet deep so there is little temperature stratification during the ice-free period, largely because of wind action. Reduced oxygen levels occur with depth due to decomposing aquatic vegetation in the fall. Once ice covered, dissolved oxygen levels may be very low. Efforts are underway through a state Clean Lakes Project to address water quality problems. The Yellowstone Soil Conservation District will address the impacts of erosion on private agricultural land bordering the lake and its tributaries. Fremont County and the Division of Environmental Quality are assessing the impact of septic tanks on the lake.

Henrys Fork and Tributaries - Water quality of the Henrys Fork and major tributaries is high when sampled above irrigated agricultural areas. Temperatures are cold enough (less than 66°F) to support coldwater fisheries year-around. Dissolved oxygen has exceeded the 6.0 mg/l minimum for the period of record.

Bacteria counts seldom exceed State standards except for the reach below Macks Inn on the Henrys Fork. Immediately downstream of Macks Inn, total coliform exceeded Idaho standards on all sample dates except one (Holte et al. 1973). Seasonal recreational use of the upper Henrys Fork and subsequent sewage loading lowers water quality to the point of precluding water contact recreation. Much of this area has recently been sewered. Wastes are pumped to a sewage treatment plant. Water quality in the reach should be much improved.

The nutrient content of the Henrys Fork and its tributaries is moderately high. Mineral content increases with progression south through the basin. Nutrient content sharply increases where irrigation return flows enter the streams. Between St. Anthony and Rexburg (23 miles), hardness increases 60 percent, sulfate increases 30 percent, nitrate increases 15 percent and total phosphorous increases 30 percent. Most phosphorous loading to the Henrys Fork is from Island Park Reservoir. Turbidity increases also, but sporadically. Mean turbidity at Rexburg is only slightly above upstream concentrations. Maximum summer temperature does not seem to increase downstream perhaps because downstream reaches are partially recharged with cold groundwater flows below irrigated areas in the lower basin. Summer temperatures are adequate for salmonid rearing throughout the Henrys Fork. Dissolved oxygen is suitable for salmonid rearing throughout the reach although summer lows approach 6.0 mg/l at Rexburg.

In the upper basin nutrient supplies are balanced for good attached benthic algae and aquatic macrophyte growth, but excessive growths do not usually occur in the free-flowing river because of turbulence and low water temperatures. Slowing waters sufficiently will cause algae blooms, particularly where the river is unshaded, wide, and shallow.

Special Resource Waters

Waters of the State may be designated "Special Resource Waters". Special Resource Water designations predate Idaho's anti-degradation legislation, and are aimed primarily at protecting beneficial uses against point source pollutants. Designation recognizes at least one of the following characteristics:

1. The water is of outstandingly high quality, exceeding both the criteria for primary contact recreation and cold water biota; or
2. The water is of unique ecological significance; or
3. The water possesses outstanding recreational or aesthetic qualities; or
4. Intensive protection of the quality of the water is in the paramount interest of the people of Idaho; or
5. The water is a part of the National Wild and Scenic River System, is within a State or National Park or wildlife refuge and is of prime or major importance to that park or refuge.
6. Intensive protection of the quality of the water is necessary to maintain an existing, but jeopardized beneficial use.

In the Henrys Fork basin the general criteria listed above were applied to designate the following rivers and streams as Special Resource Waters:

- Henrys Fork from its source to its mouth
- Buffalo River from its source to its mouth
- Warm River from its source to its mouth
- Falls River from its source to its mouth
- Teton River from its source to the North and South branches.

No new point source can discharge, and no existing point source can increase its discharge, above the design capacity of the existing wastewater treatment facility to any water designated as a Special Resource Water, or to a tributary of or to an upstream segment of a Special Resource Water, if pollutants in that discharge can or will result in a reduction of the water quality of the special resource water. As long as a point source discharge is regulated by an order, decree, compliance schedule, or valid discharge permit, the discharge or facility will not be subject to additional restrictions.

Nonpoint source activities that are being conducted in accordance with rules, regulations, and best management practices, or in the absence of referenced best management practices, conducted in a manner that demonstrates a knowledgeable and reasonable effort to minimize resulting adverse water quality impacts, will not be subject to conditions or legal actions. If water quality monitoring and surveillance show that water quality criteria are not being met, or that beneficial uses of special resource waters are being impaired as a result of a nonpoint source activity by itself, or in combination with other point and nonpoint source activities then the Director of the Idaho Department of Health and Welfare may prepare a compliance schedule or institute administrative or civil proceedings.

The following are approved best management practices for the purpose of Idaho Department of Health and Welfare Rules and Regulations:

Idaho Forest Practices Rules
Idaho Department of Health and Welfare Rules Governing Solid Waste Management

Idaho Department of Health and Welfare Rules Governing Subsurface and Individual Sewage Disposal Systems
Rules and Regulations and Minimum Standard for Stream-Channel Alterations as adopted by the Water Resource Board

Stream Segments of Concern

Idaho Executive Order 88-23 provides for designation of Stream Segments of Concern through public nomination and the Water Quality Advisory Working Committee. Designated Stream Segments of Concern will receive priority for water quality management and monitoring by state and federal agencies. A coordinated water quality monitoring program will be implemented to provide current and ongoing data, report on the status of beneficial uses and monitor the effectiveness of Best Management Practices in meeting water quality standards and protecting existing beneficial uses. Designated Stream Segments of Concern in the Henrys Fork basin are:

Henrys Lake
Falls River - Headwaters to Henrys Fork
Warm River - Warm River Springs to Henrys Fork
Robinson Creek - Yellowstone NP to Warm River
Fish Creek - Headwaters to Robinson Creek
Porcupine Creek - Headwaters to Robinson Creek
Rock Creek - Yellowstone NP to Porcupine Creek
Teton River - Headwaters to Bitch Creek

Recommended Action

1. Study the impacts upon the fishery of phosphorous and nitrogen loadings to Henrys Lake, Island Park Reservoir, the Upper Henrys Fork and the Upper Teton River. Studies should consider all sources including livestock. Administrative entities are encouraged to take early action to implement corrective measures.
2. Determine the impact of lessening and of increasing the level of nutrients introduced from ground-water movement to surface water of homesite waste water near the above water bodies.
3. In the lower Henrys Fork basin and in the upper Teton River basin, determine the best method to eliminate or reduce bacteria levels in each rural drinking water well.
4. Determine radium-226 levels in each rural well located in rhyolitic rock areas.
5. In the lower Henrys Fork basin, study the impact of agriculture nitrogen movement into the perched water system and subsequently into the Henrys Fork and Teton River. Similarly, determine the impact of pesticide movement in the water system.
6. To provide control of sheet erosion in sloping cropped land, agricultural agencies should maintain their research and educational programs for improved best management practices.
7. Develop methods to reduce the sediment load of irrigation field and dryland farm runoff to improve fishery resources in the lower Henrys Fork and lower Teton rivers. These methods may enhance aquifer recharge which benefits out-of-basin areas. Tail water pump-back systems may be part of the solution. Cost-share methods of implementation should be developed to carry out this objective.

Sources

Bennett, David H., C. Michael Falter and Robert G. White, 1980. *Columbia Basin Water Withdrawal Environmental Review, Appendix D Fish-Part II, Snake River.* Portland: U.S. Army Corps of Engineers.

IDHW. Title 1, Chapters 2 and 8, *Water Quality Standards and Wastewater Treatment Requirements,* and *Idaho Regulations for Drinking Water Systems.*

Duval, Joseph S., 1990. "Uranium in the United States." *United States Geological Survey Yearbook, Fiscal Year 1989.* Denver: U.S. Geological Survey.

IDHW, 1990. Communication with Craig Shepard, Boise, and George Spinner, Pocatello, Division of Environment, Idaho Department of Health and Welfare.

IDHW, 1988. *Idaho Water Quality Status Report and Nonpoint Source Assessment.*

Parliman, D.J., 1983. *Reconnaissance of Ground-Water Quality, Eastern Snake River Basin, Idaho.* U.S. Geological Survey. Water Resources Investigations 82-4004.

Water Quality and Pollution Control, Appendix XII, Columbia-North Pacific Region Comprehensive Framework Study, 1971. Vancouver, Washington: Columbia-North Pacific Technical Staff, Pacific Northwest River Basins Commission, Vancouver, Washington.

Whitehead, R.L., 1978. *Water Resources of the Upper Henrys Fork Basin in Eastern Idaho.* Water Information Bulletin No. 46, Idaho Department of Water Resources, prepared by the U.S. Geological Survey.

Zimmer, David W., 1981. *Water Quality in Island Park Reservoir.* U.S. Bureau of Reclamation, Pacific North Region, Pacific Northwest Region.

Water Supply and Water Conservation

Current Water Supply

Average precipitation varies greatly from less than 10 inches in the lower valley near the mouth of the Henrys Fork, to over 70 inches in the Teton peaks. Precipitation at the higher elevations varies from 25 to 40 inches (Figure 21). Weekly long-term temperature and precipitation data for Ashton, Idaho Falls, and Island Park Dam are in the Appendix. Table 48 is a water budget for the basin based on watermaster records and estimates of other water use. Precipitation averages 24.1 inches over the entire 3,220 square miles of the basin (including the Wyoming portion). This translates into 4,139,000 acre-feet of water.

For the areas covered by watermaster records, consumptive use is 27 percent of diversions. Ground-water recharge is 64 percent of the diversion. Return flows average 9 percent of the diversions. River outflow from the basin averages 1,400,00 acre-feet. The watermaster's records indicate approximately 700,000 acre-feet of diverted water percolate to the subsurface and recharge the groundwater. An additional 500,000 acre-feet are estimated to recharge the aquifer either directly from precipitation or as leakage from surface water. Approximately 200,000 acre-feet of this annual

recharge are pumped and consumptively used within the basin. The remaining precipitation (1,000,000 acre-feet) evaporates or is used by vegetation.

Table 48. Water Budget - Henrys Fork Basin

Drainage Area	3,220 square miles	
Average Precipitation	24.1 inches	4,139,000 ac-ft
Average River Outflow	2,100 cfs	1,407,000 ac-ft
Surface Diversions:		
Madison and Fremont Co.- Watermaster Records		1,100,000 ac-ft
Irrigation Consumption	300,000 ac-ft	
Return Flow	100,000 ac-ft	(100,000 ac-ft)
Ground-water Recharge	700,000 ac-ft	
Other Madison and Fremont Co. Consumption		100,000 ac-ft
Teton County Consumption		100,000 ac-ft
Ground-water Consumption (all counties)		200,000 ac-ft
Natural and Dryland Evapotranspiration plus Ground-water Recharge		1,300,000 ac-ft

Table 49 shows the estimated annual flow based on 1985 conditions at various gages for the low flow year of record, 1934; a recent low flow year, 1977; the average flow, and for a high flow year, 1984. Graphs of maximum, average, and minimum daily flow for two stations on the lower Henrys Fork and Teton Rivers are also presented (Figure 22). These graphs show the extreme variation in flow throughout the year. A bar-chart of annual flows for the Henrys Fork near Rexburg shows a great variability from the 1,400,000 acre-feet average. The yearly surface outflow varies from 600,000 to 3,000,000 acre-feet. Gages at Ashton and on the Teton River at St. Anthony do not show comparable variability. River diversions are fairly constant (Figure 23). Water storage in the basin is provided by the reservoirs listed in Table 50.

Table 49. Annual Flows (Adjusted to 1985 Development Levels)

	(1000 acre-feet)			
	1934	1977	Average	1984
Henrys Fork near Lake	33	37	39	82
Henrys Fork below Island Park	290	460	429	785
Falls River near Squirrel	357	385	564	831
Henrys Fork near Ashton	722	1087	1068	1714
Teton River above damsite	289	338	561	921
Teton River near St. Anthony	320	356	575	931
Henrys Fork near Rexburg	436	1019	1407	3001

There is some storage on the Henrys Fork, although, Henrys Lake Reservoir is located so high in the headwater area that the average runoff into the reservoir is only about 40,000 acre-feet. Island Park, Grassy Lake and Sheridan reservoirs generally fill even if emptied the previous year. The reservoirs owned by the Idaho Department of Fish and Game are used for fish and wildlife purposes so storage water generally is not released. For the Teton River drainage there is no storage, while for the similar-sized Falls River there is only minor storage available.

Table 50. Water Storage Reservoirs in the Henrys Fork Basin

Storage Reservoir	Owner	Built	Active Capacity in Acre-Feet	Stream
Island Park	USBR	1938	127,000	Henrys Fork
Henrys Lake	Private	1923	90,000	Henrys Fork
Grassy Lake (Wyoming)	USBR	1939	15,000	Falls R. Trib.
Sheridan	Private	1947	3,398	Sheridan Cr.
Silver Lake	IDPR	1915	2,548	Thurman Cr.
Lower Arcadia	Private	1912	882	Sand Cr. Trib.
Blue Cr. #4	IDPR	1960	390	Sand Cr. Trib.
Golden Lake	IDFG	1915	360	Thurman Cr.
Upper Arcadia	Private	1912	300	Sand Cr. Trib.
Bergman (Wyoming)	Private	1953	201	Squirrel Cr. Trib.
Blue Cr. #3	IDFG	1965	168	Sand Cr. Trib.
Upper Blue Cr.	IDFG	1950	166	Sand Cr. Trib.
Upper Mikesell	Private	1945	130	Sand Cr. Trib.
Blue Cr. #2	IDFG	1940	77	Sand Cr. Trib.
Lower Mikesell	Private	1940	70	Sand Cr. Trib.
Blue Cr. #1	IDFG	1977	56	Sand Cr. Trib
TOTAL			230,000 AF	

In order to better understand the low percentage of consumptive use in the basin (27 percent of diversions) a canal-by-canal listing of water diversion, use, and groundwater recharge is provided in Table 51 for a full water supply year, 1986, while Table 52 illustrates a poor water year, 1977. Figure 24 is a schematic of the basin's canal system. Irrigated land is broken down into three water supply sources. A summary of water use is shown in Table 53.

A great deal of water is diverted from the Henrys Fork. Diversion is 16.6 acre-feet per acre (662,000 acre-feet) in a good water year and 9.5 acre-feet per acre (383,150 acre-feet) in a very poor water year. The historic method of irrigation in this area has been by subirrigation. Several of the canals have some water in them year-round. This water almost entirely moves into and raises the perched ground-water level. Since 1939 Island Park Reservoir has filled so the winter nonirrigation season release of water for groundwater recharge almost without exception has not influenced the filling of the reservoir. See Figure 25 for a view of variability of the diversions by month and the amount of winter diversions.

On the Egin Bench on the north side of the Henrys Fork, the regional water table varies from 40 feet deep at Plano to 100 feet deep at Parker. Figure 26 shows the current irrigation method and change from 1966 when virtually the entire area was subirrigated. On the south side of the Henrys Fork, changes are being made in irrigation methods, but at a slower rate. Subirrigation on the south side of the river appears to be incidental to flood irrigation. The geologic section (Figure 27) of the Lower Henrys Fork Valley shows high summer water levels for the Sugar City-Hibbard area. The levels may no longer be as high because of a major shift to sprinkler use in the area.

Figure 21:
Precipitation Contours

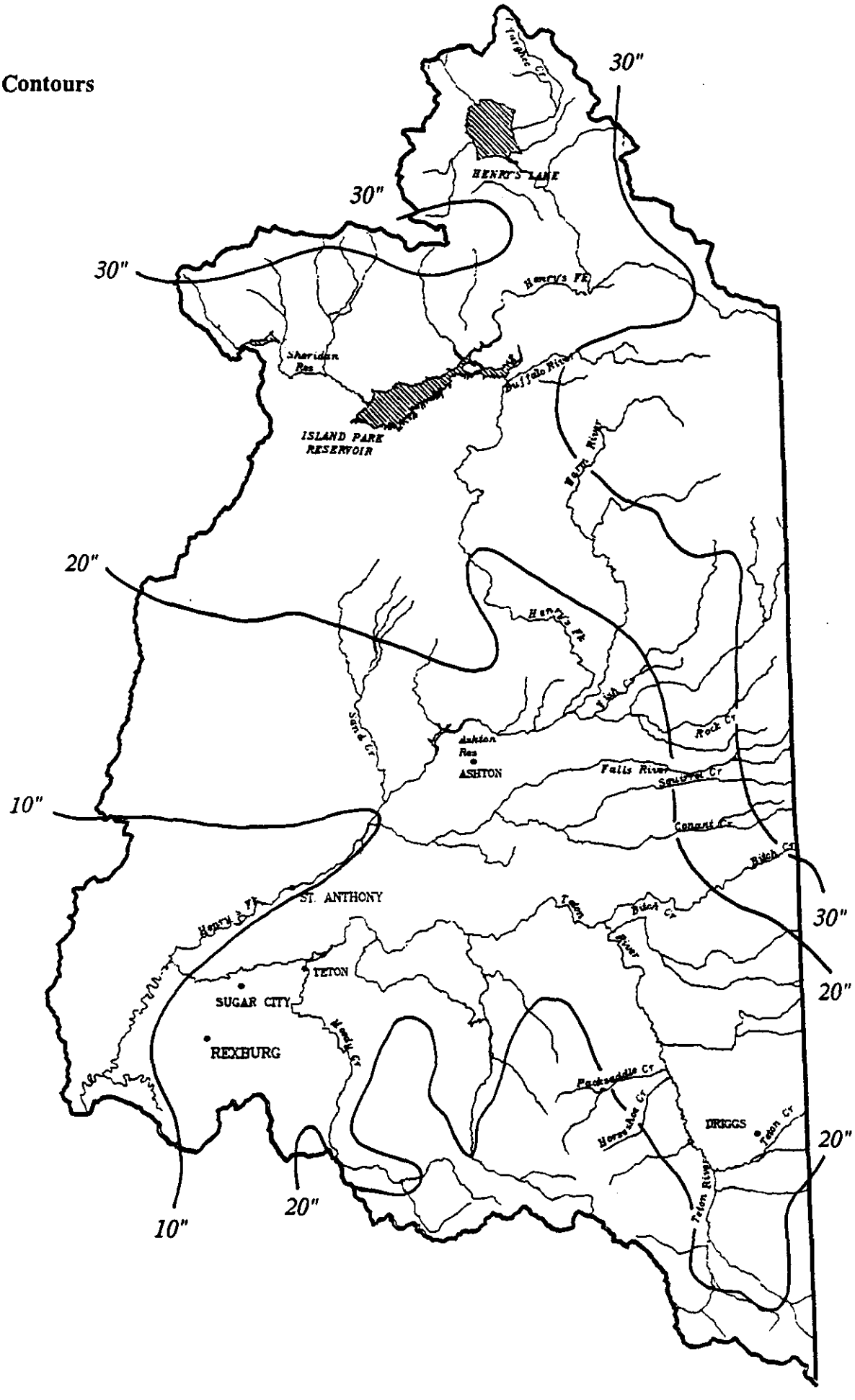
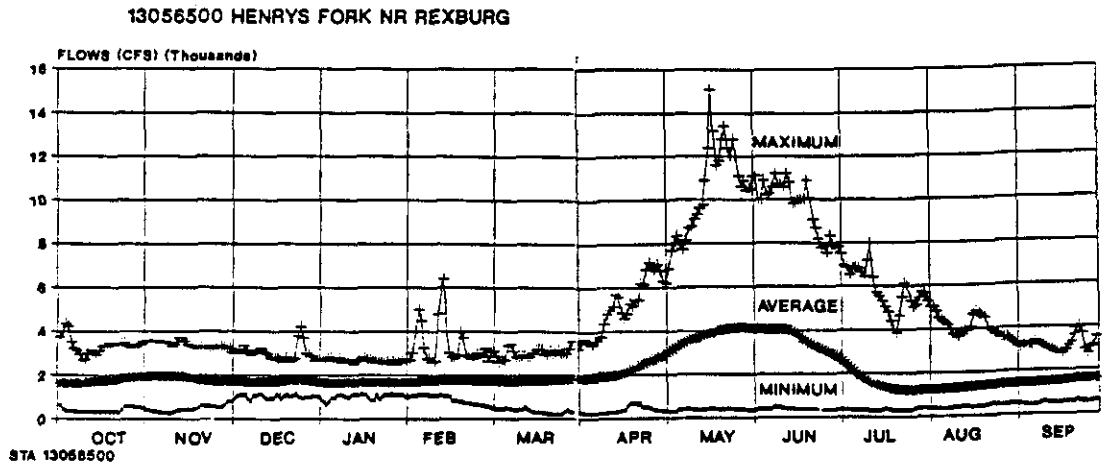


Figure 22:
Annual Discharge - Henrys Fork



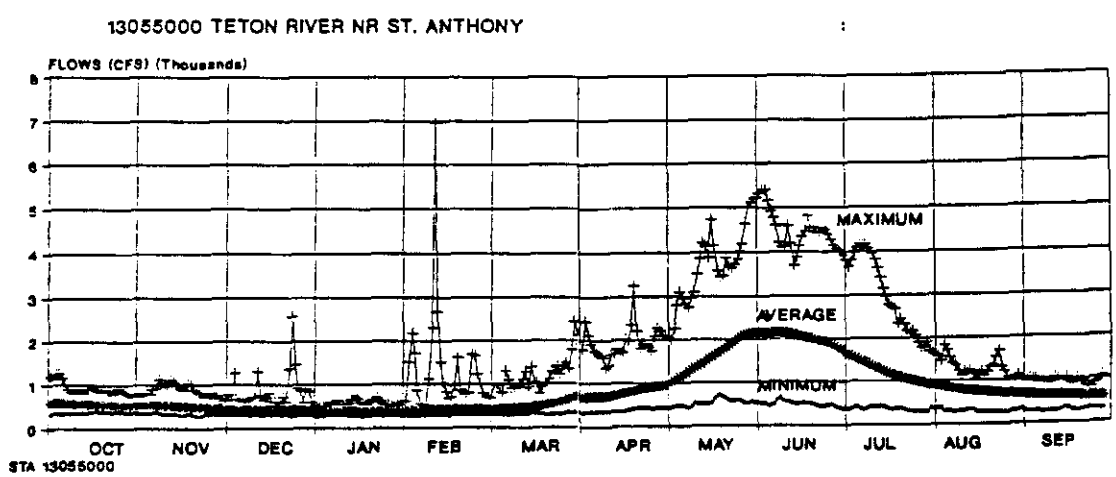
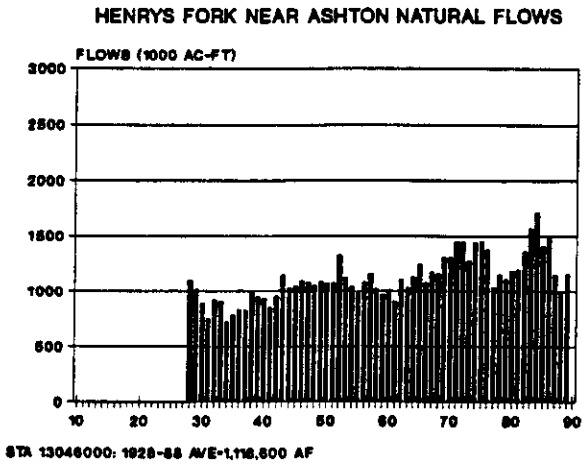
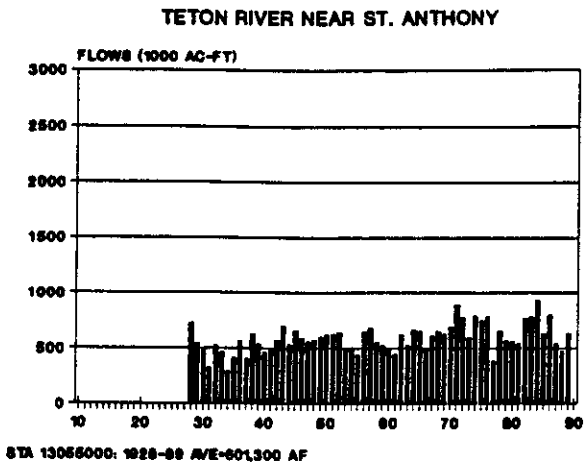
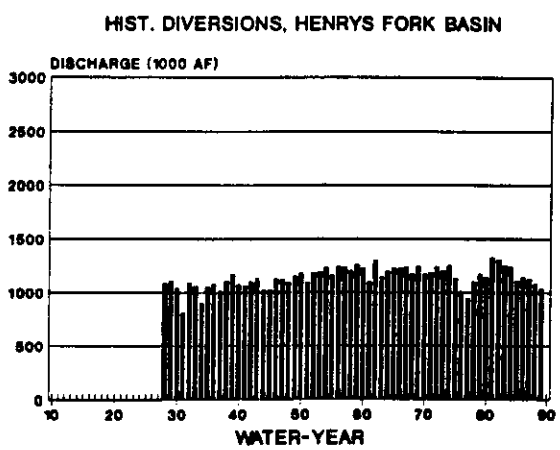


Figure 23:
Discharge and Diversions - Henrys Fork







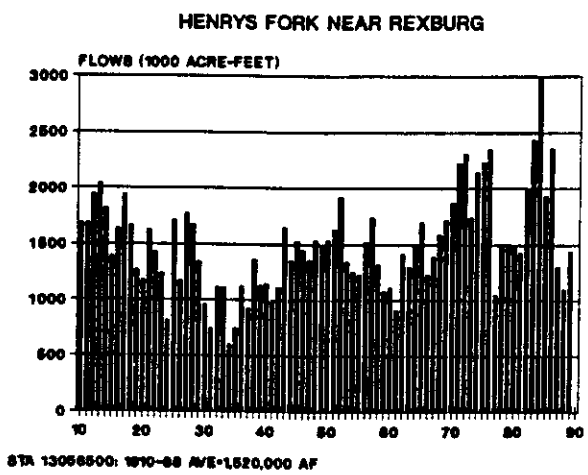


Table 51. Canal Records - 1986

Name	Recorded Acres	Calculated Acres*	Diversion Ac-ft	Ac-ft/Ac	% Return Flow	Return Flow Ac-ft/Ac	Consumptive Use Ac-ft/Ac	Groundwater Recharge Ac-ft/Ac	Total Recharge Ac-ft
Dewey	1,200		6,700	5.6	5	0.3	2.1	3.2	3800
Last Chance	1,860	2,630	27,300	10.4	10	1.0	2.1	7.2	19,000
Farmers Friend	3,025	2,250	44,300	19.7	14	2.8	2.1	14.8	33,400
Twin Groves	2,500	2,420	34,700	14.3	10	1.4	2.1	10.8	26,100
St. Anthony Union	9,700		161,400	16.6	10	1.7	2.1	12.9	124,900
Salem Union	5,500	4,367	64,300	14.7	8	1.2	2.1	11.4	50,000
Egin	7,000	6,030	109,300	18.1	10	1.8	2.1	14.2	85,700
St. Anthony U. Feeder	2,300		28,700	12.5	10	1.2	2.1	9.1	21,000
Independent	6,000	6,525	106,500	16.3	3	0.5	2.1	13.7	89,600
Consolidated Farmers	6,000	2,432	78,800	>12.5	6	0.8	2.1	9.6	23,300
Subtotal	45,085	39,854	662,000						476,800
Falls River									
Yellowstone	2,100		3,136	1.5	0	0.0	2.1	0.0	0
Marysville	16,000		30,300	1.9	0	0.0	2.1	0.0	0
Farmers Own	5,800		18,900	3.3	5	0.2	2.1	1.0	5800
Conant Creek	1,680		3,463	2.1	0	0.0	2.1	0.0	0
Boom Creek	2,180		512	0.2	0	0.0	2.1	0.0	0
Squirrel Creek	1,165		2,158	1.9	0	0.0	2.1	0.0	0
Orme			123		0		2.1		
Enterprise	5,890	1,340	20,000	14.9	10	1.5	2.1	11.3	15,200
Fall River	9,000	6,780	86,800	12.8	14	1.8	2.1	8.9	60,400
Chester	1,400	1,240	15,100	12.2	5	0.6	2.1	9.5	11,700
McBee	125		500	4.0	5	0.2	2.1	1.7	200
Silkey	1,080		4,748	4.4	5	0.2	2.1	2.1	2200
Curr	1,300		17,200	13.2	10	1.3	2.1	9.8	12,800
Subtotal	47,720	40,790	202,940						108,300
Lower Teton River									
Canyon Creek	2,200		5,845	2.7	0	0.0	2.1	0.6	1200
Wilford	2,630	2,005	42,200	21.0	17	3.6	2.1	15.4	30,800
Teton Irrigation	2,500	2,954	23,100	7.8	39	3.0	2.1	2.7	7900
Siddoway	240		1,388	5.8	5	0.3	2.1	3.4	800
Pioneer	300		2,860	9.5	5	0.5	2.1	7.0	2100
Stewart	480		3,543	7.4	5	0.4	2.1	4.9	2400
Pincock-Byington	260	243	2,817	11.6	0	0.0	2.1	9.5	2300
Teton Island Feeder	10,400		121,700	11.7	11	1.3	2.1	8.3	86,500
North Salem	450		1,972	4.4	5	0.2	2.1	2.1	900
Roxana	880	665	5,006	7.5	5	0.4	2.1	5.1	3400
Island Ward	3,300	4,493	7,817	>12.5	6	0.8	2.1	9.6	43,100
Saurey-Sommers	275	289	4,046	14.0	10	1.4	2.1	10.5	3000
McCormick-Rowe	160		345	2.2	0	0.0	2.1	0.1	0
Pincock-Garner	480	370	1,999	5.4	0	0.0	2.1	3.3	1200
Bigler Slough	240	180	1,115	6.2	0	0.0	2.1	4.1	700
Woodmansee-Johnson	1,320	1,295	2,462	1.9	10	0.2	2.1	0.0	0
City of Rexburg	950	250	5,546	22.2	9	2.0	2.1	18.1	4500
Rexburg Irrigation	5,280	5,655	54,500	9.6	5	0.0	2.1	7.5	42,600
Subtotal	32,345	32,639	288,261						233,400
Total	125,150	113,283	1,153,201						818,500

* See Wytzes. Further mapping review needs to be made of the Consolidated Farmers system.
> Average of Consolidated Farmers and Island Ward (dual operation)

Table 52. Canal Records - 1977

Name	Recorded Acres	Calculated Acres*	Diversion Ac-ft	Ac-ft/Ac	% Return Flow	Return Flow Ac-ft/Ac	Consumptive Use Ac-ft/Ac	Groundwater Recharge Ac-ft/Ac	Total Recharge Ac-ft
Dewey	1,200		2,360	2.0	5	0.1	2.1	0.0	0
Last Chance	1,860	2,630	12,850	4.9	10	0.5	2.1	2.3	6000
Farmers Friend	3,025	2,250	8,650	3.8	14	0.5	2.1	1.2	2700
Twin Groves	2,500	2,420	17,830	7.4	10	0.7	2.1	4.5	11,000
St. Anthony Union	9,700		115,370	11.9	10	1.2	2.1	8.6	83,500
Salem Union	5,500	4,367	41,250	9.4	8	0.8	2.1	6.6	28,800
Egin	7,000	6,030	80,360	13.3	10	1.3	2.1	9.9	59,700
St. Anthony U. Feeder	2,300		29,210	12.7	10	1.3	2.1	9.3	21,500
Independent	6,000	6,525	28,000	4.3	3	0.1	2.1	2.1	13,500
Consolidated Farmers	6,000	2,432	47,270	>7.3	6	0.4	2.1	4.8	11,700
Subtotal	45,085	39,854	383,150						238,400
Falls River									
Yellowstone	2,100		1,468	0.7	0	0.0	2.1	0.0	0
Marysville	16,000		24,240	1.5	0	0.0	2.1	0.0	0
Farmers Own	5,800		11,590	2.0	5	0.1	2.1	0.0	0
Conant Creek	1,680		2,696	1.6	0	0.0	2.1	0.0	0
Boom Creek	2,180		890	0.4	0	0.0	2.1	0.0	0
Squirrel Creek	1,165		1,092	0.9	0	0.0	2.1	0.0	0
Orme			123		0		2.1		
Enterprise	5,890	1,340	20,100	15.0	10	1.5	2.1	11.4	15,300
Fall River	9,000	6,780	66,800	9.9	14	1.4	2.1	6.4	43,200
Chester	1,400	1,240	4,890	3.9	5	0.2	2.1	1.6	2000
McBee	125		61	0.5	5	0.0	2.1	0.0	0
Silkey	1,080		3,650	3.4	5	0.2	2.1	1.1	1200
Curr	1,300		9,840	7.6	10	0.8	2.1	4.7	6100
Subtotal	47,720	40,790	147,317						67,800
Lower Teton River									
Canyon Creek	2,200		1,590	0.7	0	0.0	2.1	0.0	0
Wilford	2,630	2,005	14,960	7.5	17	1.3	2.1	4.1	8200
Teton Irrigation	2,500	2,954	18,140	6.1	39	2.4	2.1	1.6	4900
Siddoway	240			0.0	5	0.0	2.1	0.0	0
Pioneer	300		282	0.9	5	0.0	2.1	0.0	0
Stewart	480		930	1.9	5	0.1	2.1	0.0	0
Pincock-Byington	260	243	1,154	4.7	0	0.0	2.1	2.6	600
Teton Island Feeder	10,400		55,690	5.4	11	0.6	2.1	2.7	27,700
North Salem	450		48	0.1	5	0.0	2.1	0.0	0
Roxana	880	665	2,610	3.9	5	0.2	2.1	1.6	1100
Island Ward	3,300	4,493	3,130	>7.3	6	0.4	2.1	4.8	21,600
Saurey-Sommers	275	289	3,090	10.7	10	1.1	2.1	7.5	2200
McCormick-Rowe	160		103	0.6	0	0.0	2.1	0.0	0
Pincock-Garner	480	370	958	2.6	0	0.0	2.1	0.5	200
Bigler Slough	240	180	80	0.4	0	0.0	2.1	0.0	0
Woodmansee-Johnson	1,320	1,295	1,610	1.2	10	0.1	2.1	0.0	0
City of Rexburg	950	250	2,450	9.8	9	0.9	2.1	6.8	1700
Rexburg Irrigation	5,280	5,655	39,310	6.9	5	0.0	2.1	4.8	27,400
Subtotal	32,345	32,639	146,135						95,600
Total	125,150	113,283	676,602						401,800

* See Wytzes. Further mapping review needs to be made of the Consolidated Farmers system.
> Average of Consolidated Farmers and Island Ward (dual operation)

Figure 24:
Storage and Diversion Schematic - Henrys Fork Basin

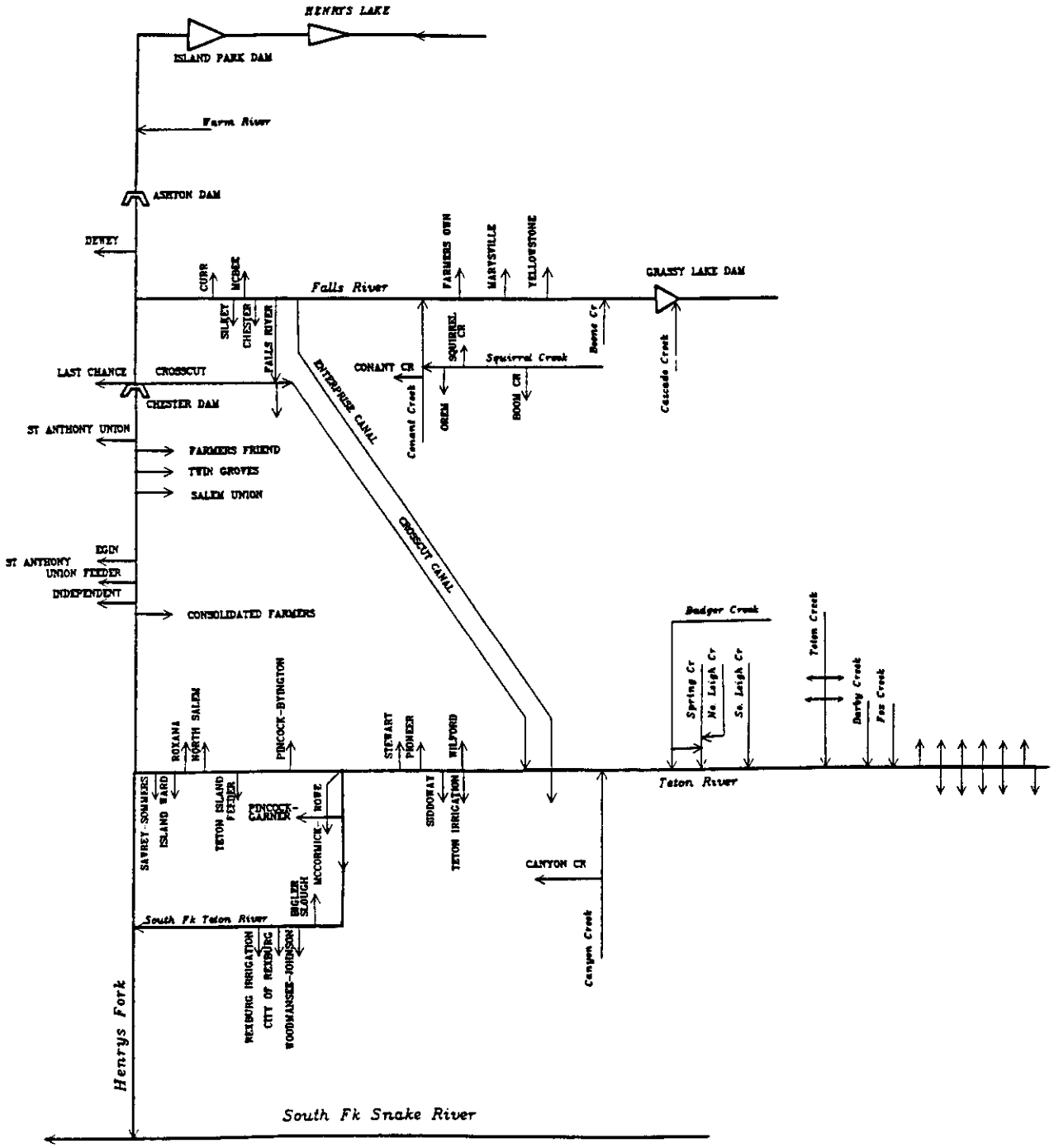
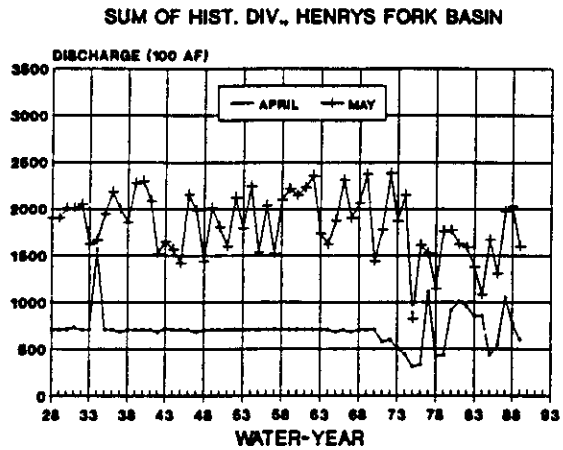
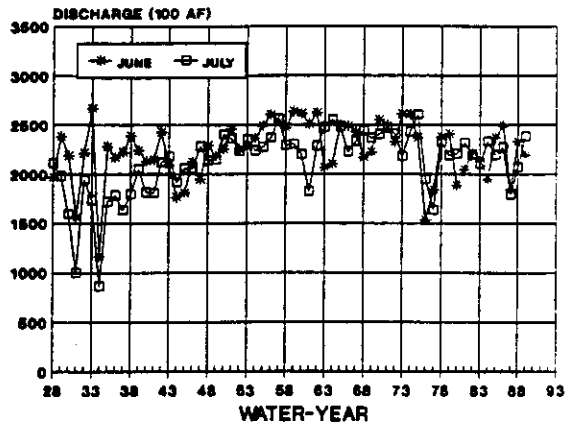
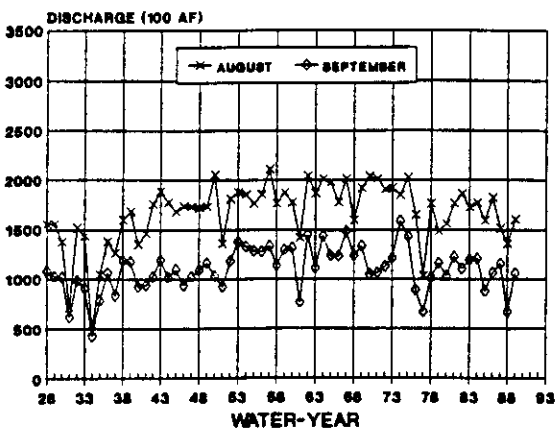


Figure 25:
Diversions - Henrys Fork Basin







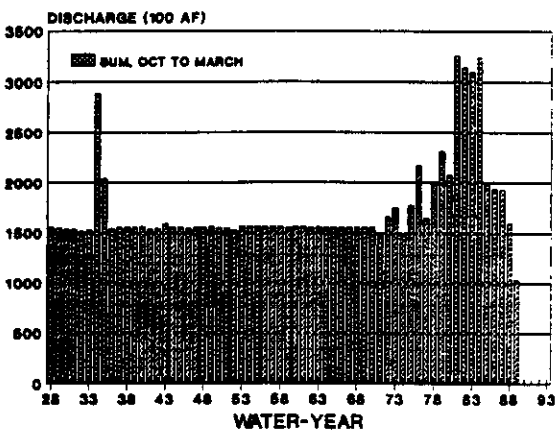


Figure 26. Egin Bench Irrigation Methods

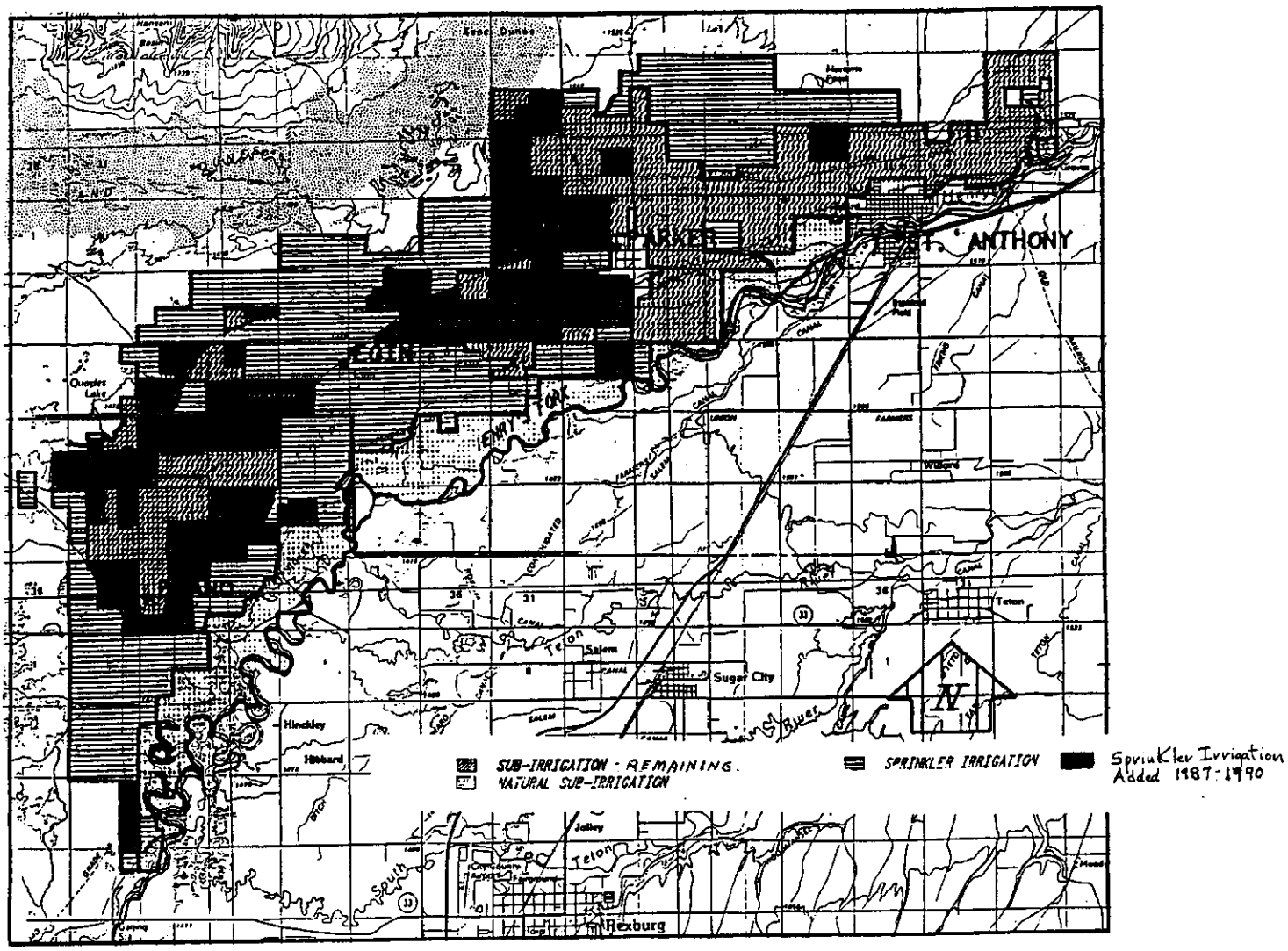


Table 53. Water Use Summary

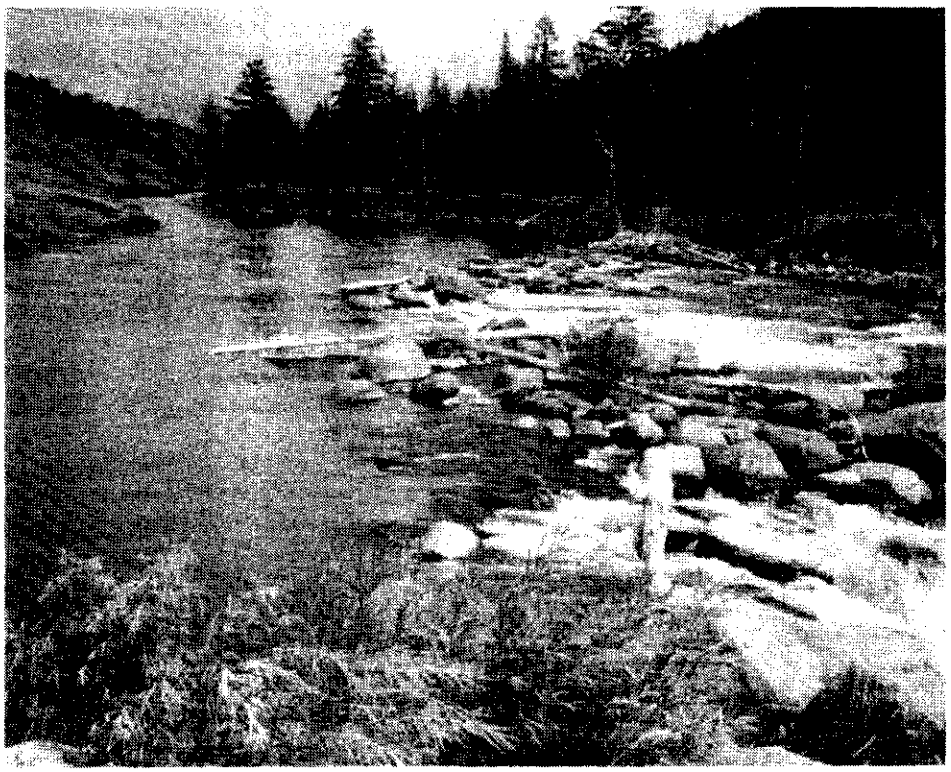
1986	Acres	Diversions/AC	Return Flow	Consumptive* Use	Groundwater Recharge
Falls River	40,800	5.0	0.7	2.1	2.7
Teton River	32,600	8.8	1.2	2.1	6.2
Henrys Fork	39,900	16.6	1.4	2.1	13.1
1977					
Falls River	40,800	4.0	0.4	1.9	2.0
Teton River	32,639	4.8	0.6	1.9	2.5
Henrys Fork	39,900	9.5	0.8	1.9	6.8

* Some areas used less, so the average will be less than indicated amount

In 1987 the Department of Water Resources did a study of irrigation on the Egin Bench; the mapping was recently updated. The 1987 study identified 27,600 acres under cultivation in the upper bench area. The acreage by irrigation method by year was:

	Sprinkler Irrigation	Natural Subirrigation	Subirrigation
1966	200	24,700	2,700
1987	9,600	15,300	2,700
1990	16,000	8,900	2,700

The recent rapid change in irrigation method is due to better potato yields and grade with sprinkler irrigation. At the current rate of change, it appears that nearly all subirrigated land other than natural subirrigated land will be changed to sprinkler irrigation within a few years.



Yellowstone Diversion on the Falls River.

If subirrigation were eliminated, the per acre use would drop to approximately 5.0 acre-feet. For a short water year, such as 1977, there would be 4.5 acre-feet per acre water savings. Somewhere on the order of 112,000 acre-feet (24,900 acres x 4.5) would have been available for other users.

In some cases, water diversions to field perimeter ditches continue year-round, and contribute to the large per-acre use of water. If not diverted to the field perimeter ditches natural flow would be available to the next junior water right holder. During the nonirrigation season and early spring runoff period, water not diverted would be stored (on-paper) in one of the following reservoirs listed in order of priority: Henrys Lake, American Falls, Island Park, or by exchange Palisades--if American Falls fills.

Ground Water

The valley portions of this study area generally yield relatively high amounts of groundwater. These are the areas that generally are presently irrigated. In the Teton Valley the depth to groundwater in many areas is 50 feet or less. Downriver from St. Anthony the regional water table depth decreases from about 100 feet to 50 feet between Egin and Sugar City, and approaches zero near the mouth of the Henrys Fork. Depth to groundwater beneath the adjacent bench-land areas is of course proportionally deeper. The perched water table in the valley down river from St. Anthony and in the Ashton area may approach the surface (see Figure 28).

Irrigation in the Ashton-Marysville area and downriver about six miles appears to have created perched water at less than 50 feet in many places. Basalts underlying the St. Anthony-Rexburg area and the area south of the Teton River are relatively porous and have good water yield potential.

South of the Falls River, in the Grainville-Squirrel-Lamont area, the bedrock appears to consist of rhyolite, a silicic volcanic material. These rocks contain large amounts of quartz ($SiO_2 > 65\%$), and are much less porous than basalts. This same rock type nearly outcrops on the benches north and south of the Teton River in the Canyon Creek area. These areas, generally, have poor groundwater yields.

Further localized and detailed study is needed of potential groundwater sources on the south side of the Henrys Fork. Significant groundwater studies have been done of the irrigated valley area below St. Anthony, and of the Teton Valley bottomlands. Likewise, north of the Henrys Fork the depth to groundwater is generally known. In parts of the rangeland area of the basin pumping levels may be high by today's standard. The rangeland aquifer is generally a high-yielding basalt rock. In the sand dune area the subsurface geology is basalt.

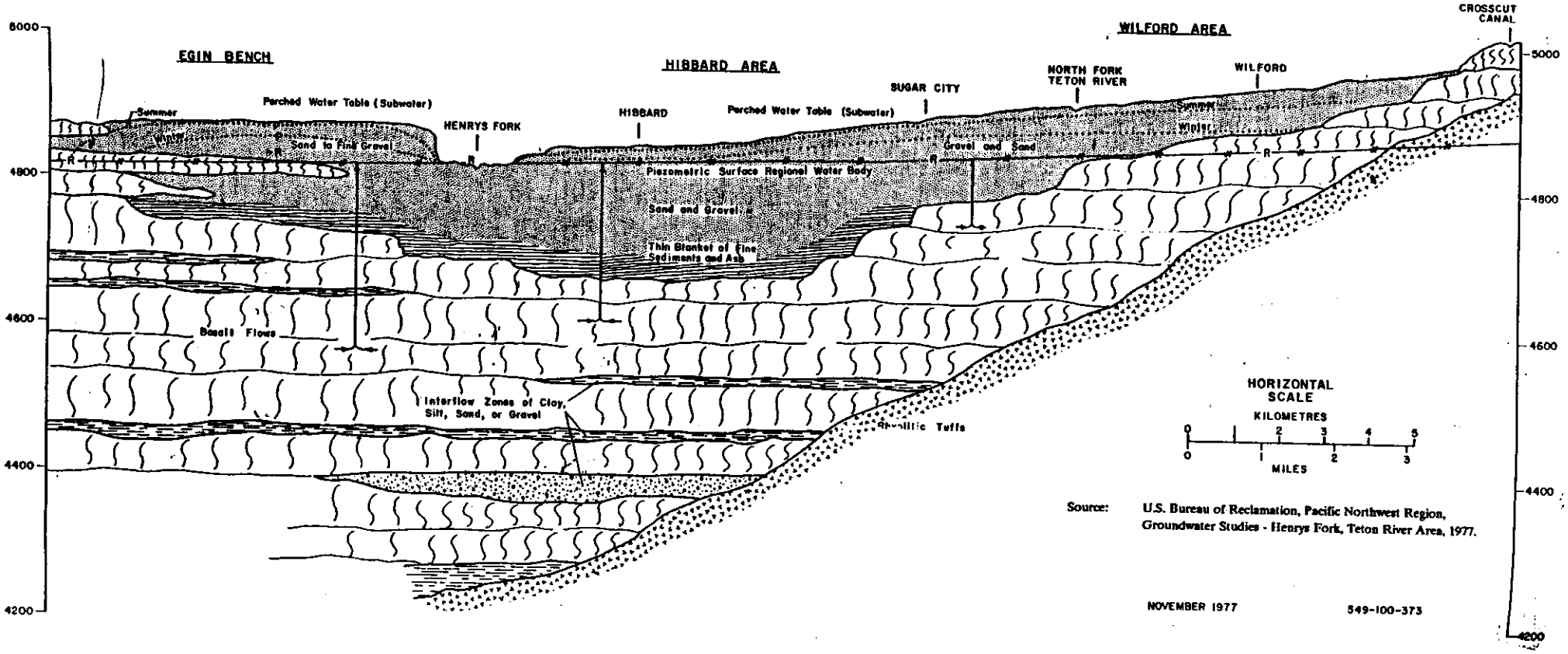
See Figures 29 and 30 for the depth to groundwater. (Note: Figure 30 generally shows deeper depths to the regional water table in the lower Henrys Fork bottom lands than the general area map for the first encounter with water. Regional water may be 100 feet deeper than the first water encountered.)

Minimum Stream Flows

A state designated minimum stream flow has been established for reaches of the Henrys Fork, the Warm River, Teton River, and Bitch Creek (see Table 54).

An application for a 140 cfs minimum instream flow on Falls River, from Highway 32 to the mouth, was withdrawn in 1985 after a local information meeting. In general, these stream flows are the minimum flow required to sustain the fishery. The summer flow established for the Henrys Fork

Figure 27:
Geological Section - Henrys Fork Valley



Source: U.S. Bureau of Reclamation, Pacific Northwest Region, Groundwater Studies - Henrys Fork, Teton River Area, 1977.

Figure 28:
Perched Water Tables - Lower Henrys Fork

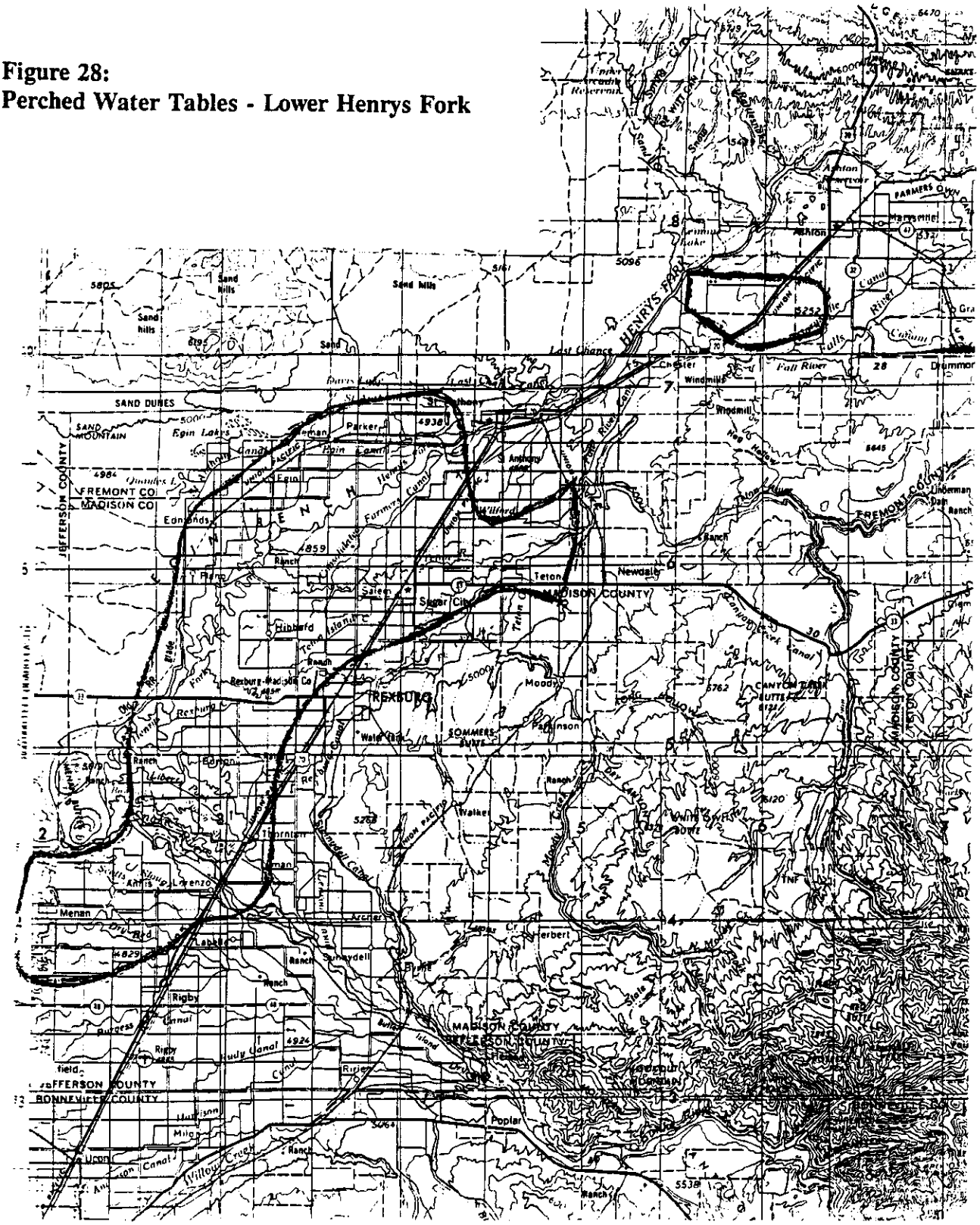
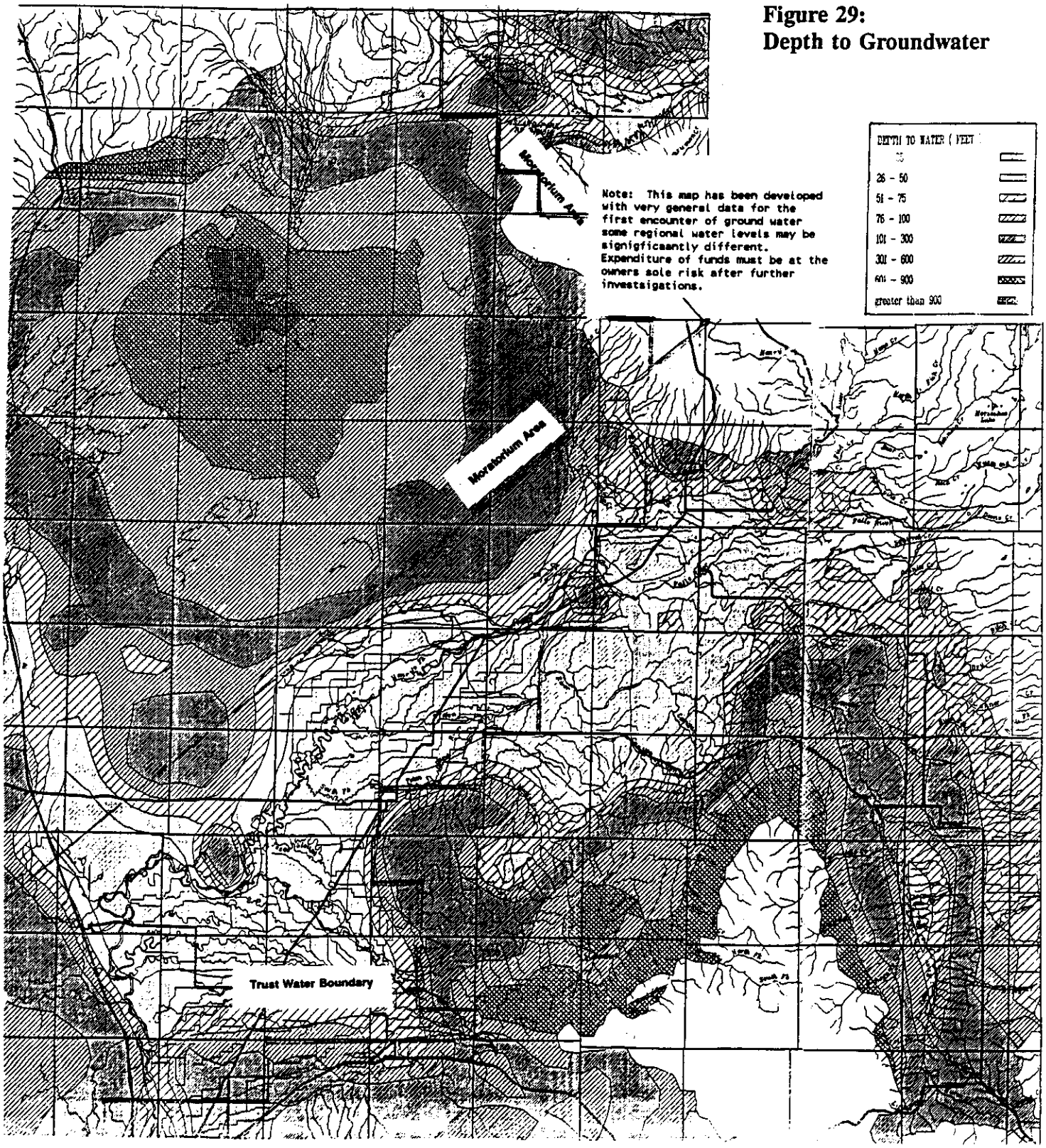
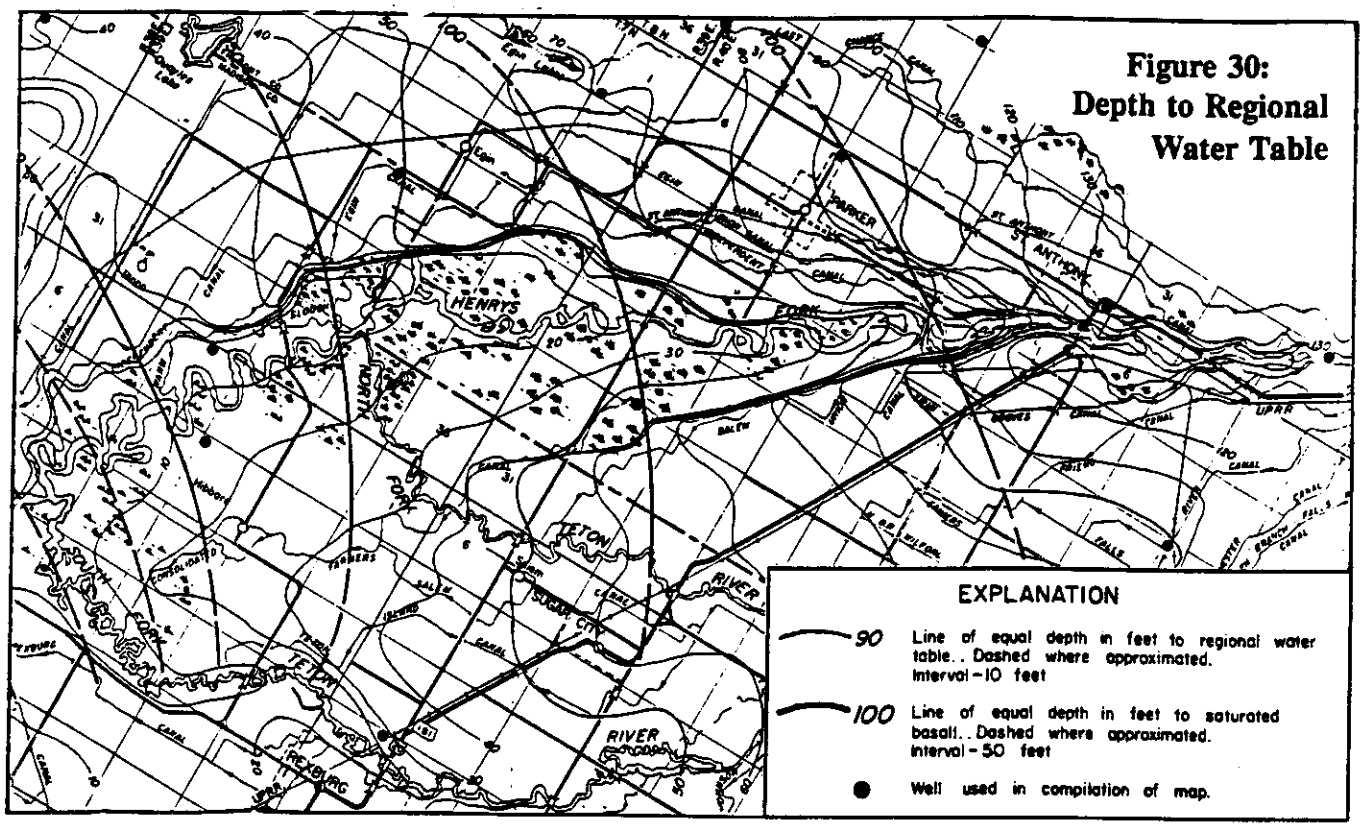


Figure 29: Depth to Groundwater





Source: Ham, Herbert, U.S. Bureau of Reclamation, Teton Basin Project, 1968.

is tied to the recent historical flow of this stream and is provided largely for aesthetic and recreational purposes, including flow over Upper and Lower Mesa Falls and through Harriman State Park.

Table 54. Minimum Stream Flows - Henrys Fork Basin

Stream	Priority Date	Amount	Dates	River Area
Henrys Fork	9-23-81	300 cfs 1000 cfs	10-1 to 3-31 4-1 to 9-30	One mile above Upper Mesa Falls to one mile below Lower Mesa Falls (2 miles)
Henrys Fork	9-23-81	300 cfs	1-1 to 12-31	The mouth of the Buffalo River (one mile below Island Park Dam) to one mile above Upper Mesa Falls (about 24 miles)
Warm River	11-20-85	141 cfs	1-1 to 12-31	Warm River Springs to mouth (about 8 miles)
Teton River	11-21-85	106 cfs	1-1 to 12-31	Highway 33 to confluence with Bitch Creek (about 9 miles)
Bitch Creek	11-21-85	28 cfs	1-1 to 12-31	Highway 32 to mouth (about 7.5 miles)

Potential Water Supplies

1. Surface Water Storage Sites

In the Henrys Fork Basin significant water storage occurs only on the upper main stem of the Henrys Fork. Any new storage developed in the Henrys Fork basin would have to be used in conjunction with other Water District 01 reservoirs. As the junior water right, new storage could not be filled until downstream reservoirs above Milner Dam were full. In dry years water for storage would have to be purchased or leased from other right holders. In most dry years there is rental pool water available. There may be an occasional year, such as 1977, when the open market would have to satisfy some of the rental water need.

Twenty some potential surface storage sites have been identified within the basin. None of these sites are being actively pursued at this time because of financial or environmental constraints. New storage for irrigation should be located in the upper reaches of the basin. Lower elevation level storage such as at Teton or Warm River would require significant pump lifts for use on high ground. Table 55 lists some potential reservoir sites in the basin. Off-stream sites (sites that would need water from an adjacent drainage) are generally listed first. All potential "Off-Stream" sites could be smaller and use only the water from their drainage basin. A few small storage sites (2,000 to 10,000 acre-feet) are known in the basin, but are not identified here. (See p. 213 and other Chapter 7 projects of the "Upper Snake River Basin Wyoming-Idaho-Utah-Nevada-Oregon, Vol. 1, Summary Report" published by the U.S. Department of Interior, Bureau of Reclamation.)

Moody Creek - Sec. 3, T. 5 N., R. 41 E. - This site, on a south-side tributary to the lower Teton River, would have a 300-foot high dam with a short 1,300-foot length. It could store 50,000 acre-feet in a narrow canyon at the 5,400 feet elevation level. About 6,000 acre-feet of storable water would be available from Moody Creek and about 9,000 acre-feet would be available from Canyon Creek through a gravity canal about 15 miles long. The majority of the water would need to be brought from the Teton River through a canal approximately 10 miles long coupled with a pumping plant to lift the water about 350 feet. The water, of course, could come from the Upper Teton River Basin with no net lift through a 25 mile canal. The adjacent drylands generally start at the 5,400 feet level so the water used would have to be pumped 200 to 400 feet above the reservoir.

Spring Creek - Sec. 11, T. 5 N., R. 42 E. - This site is on a tributary to Canyon Creek, a south-side tributary to the Teton River. A dam 165 feet high and 1,000 feet long would provide for storage for 30,000 acre-feet at the 6,150 feet elevation level. About 9,000 acre-feet of water would be available through a three mile canal from Canyon Creek. The remaining needed water would require a 150-foot lift pumping plant and a 20-mile canal from the Teton River. By extending the canal another 10 miles to Bitch Creek the pumping lift could be reduced to 100 feet. This reservoir could be used to irrigate some of the higher lands southeast of Rexburg. There is 775 feet of elevation drop between this site and Teton damsite over a distance of nine miles. Some hydropower potential, therefore exists, but would prevent the water use for bench-land irrigation.

Another location for water storage in this area would be the Canyon Creek site just below the junction of Canyon, Calamity, and Warm Creeks. The waters of Calamity and Warm Creeks could not be stored at the Spring Creek site but at the Canyon Creek site. The reservoir storage level would be at about the 6,000 feet level with a dam height under 150 feet.

Lane Lake - Sec. 13, T. 7 N., R. 42 E. - This potential off-stream storage site is located in a dry basin east of St. Anthony and just to the north of the Teton River. A 150-foot high and 2,500-foot long dam would store 70,000 acre-feet of water at the 5,570 feet level. An 15 mile canal from Conant Creek would provide about 30,000 acre-feet. An additional 15 miles of canal would be needed to divert water from the Falls River in the vicinity of the Marysville diversion dam. An alternate water source would be Bitch Creek with a 25 mile canal. This would allow water to be picked up near the forest boundary in order to stay above the lower Bitch Creek Canyon. The 6,050 feet elevation at Bitch Creek could allow about 450 feet of hydroelectric head to be developed along the canal.

Table 55. Potential Reservoir Sites

Potential for Further Study by Priority	Name	Reservoir Elevation in Feet	Water Level Rise	Dam Length	Reservoir Capacity Acre-Feet	Water Source	Canal Length
	OFF-STREAM						
	Bitch Cr.	5,970	475	1,400	140,000	Falls R. or Teton R.	35 miles 20-25 miles
1	Bitch Cr.	6,010	515	1,800	210,000	60,000-Bitch Cr. & Falls R. or Teton R.	35 miles & 20-25 miles
	Moody Cr.	5,400	300	1,300	50,000	6,000 - Moody Cr. 9,000 - Canyon Cr. 35,000 - Teton R.	 15 miles 10 miles + 150 ft. lift
2	Spring Cr.	6,150	165	1,000	30,000	9,000 - Canyon Cr. 21,000 - Teton R. or 21,000 - Bitch Cr.	3 miles 20 miles + 150 ft. lift 30 miles + 100 ft. lift
1	Lane Lake	5,570	150	2,500	70,000	30,000 - Conant Cr. 40,000 - Falls R.	15 miles 30 miles
1	Lower Badger Cr.	5,900	410	1,400	70,000	Teton R.	10 miles
2	Upper Badger Cr.	5,970	130	2,600	50,000	Teton R.	10 miles
1	Conant Cr.	5,600	150	1,300	40,000	30,000 - Conant Cr. 10,000 - Falls R. or 10,000 - Bitch Cr.	 15 miles 15 miles + 400 ft hydro
	Squirrel Cr.	6,400	280	3,300	130,000	Falls R.	10 miles + 2,400 ft. lift
	Squirrel Meadows	6,440	50 & 20	1,200 & 2,500	10,000	Boone Cr.	5 miles
	Boon Cr.	6,320	290	2,800	80,000	Falls R.	10 miles + 160 ft. lift
2	Robinson Cr.	5,800	300	2,000	70,000	20,000 - Robinson Cr. 50,000 - Falls R.	 12 miles + 1 mile tunnel with J.Y. Ranch Reservoir
1	J.Y. Ranch	5,800 or 5,840	170 210	3,300	50,000 80,000	Falls R. Falls R.	12 miles 13 miles
	Howell Ranch	5,720	130	3,700	30,000	Falls R.	10 miles
	Park Lake	6,200	220	2,200	40,000	Falls R.	12 miles + 40 ft. lift
	Moose Cr.	6,640	140	1,000	60,000	Henrys Fk.	6 miles + 250 ft. lift
2	Ground-water Exchange	5,150				Falls R.	various lengths
	DIRECT STORAGE						
2	Ashton Enlargement	5,192	+38	1,000 + 4,000 dike	50,000/40,000	Henrys Fk.	
2	Teton	5,320	320	2,800	315,000/200,000	Teton R.	
	Warm River	5,478	265	1,600	140,000/75,000	Henrys Fk. & Warm R.	
	Tetonia or Driggs	6,010 6,010	140 42	1,200 6,500	590,000 50,000/35,000	Teton R.	
1	Newdale Diversion		10	900	to 2,000 cfs	Teton R.	
2	Marysville Headworks	5,740	140	3,000	56,000	Falls R.	

Lane Lake is one of four sites in the basin that the University of Idaho's Water and Energy Resources Research Institute (1981) believed had the most potential for development. Water from the project could be used for irrigation on adjacent dry-farmed land. This land could be served with a pump lift generally under 200 feet. This site also could develop about 400 feet of head through a three mile canal and penstock to the bottom of the Teton River Canyon, just upstream of the Teton damsite. However, hydroelectric use would preclude the use of that water to irrigate adjacent drylands.

Bitch Creek - Sec. 10, T. 7 N., R. 44 E. - Two miles up from the mouth of Bitch Creek, a 475-foot high dam with a 1,400 foot crest could store 142,000 acre-feet at the 5,970 feet elevation level. If the dam was raised 40 feet, to 6,010 feet, it could increase the storage capacity to nearly 210,000 acre-feet. Approximately 75,000 acre-feet is available for storage during a normal year in Bitch Creek. The remaining water would need to be diverted from the Teton River via a 20-25 mile canal originating in the Driggs area, extending over to and down Badger Creek. An alternative water source would be Falls River, near the Idaho border, and Conant Creek through a 35 mile canal. The Bitch Creek site is an alterative to the Teton Dam project. Water would be available for irrigation of adjacent Teton Bench lands and the Lamont-Drummond-Squirrel area, where groundwater appears to have limited availability.

Power generation would be possible at the site. For any power generation analysis, the diversion of spring freshet flows from the Falls River must be reviewed. For the higher reservoir the available hydropower head could range up to 515 feet. Figuring only Bitch Creek water, the estimated average annual generation is 5,000 KW. With the diversion of Teton River water to this site, generation could double. The use of water for power generation would, however, prevent the water's use for irrigation on higher land.

Lower Badger Creek - Sec. 21, T. 7 N., R. 44 E. - At the 5,900 feet elevation level, a 410-foot high, 1,400-foot long dam would store 70,000 acre-feet in this deep canyon site near the mouth of Badger Creek. A canal about 10 miles long would bring Teton River water to this site. A powerhouse at the site would allow for the capture of some hydroelectric benefits but, again, to the exclusion of irrigation of higher lands.

Upper Badger Creek - Sec. 26, T. 7 N., R. 44 E. - A 130-foot high, 2,600-foot long dam at the 5,970 feet elevation level could store about 50,000 acre-feet. Similar to the Lower Badger Creek site, this reservoir's water source would be the Teton River, via a 10 mile canal. A 1-3/4 mile tunnel to the Teton River would allow for the development of 440 feet of hydroelectric head. As in several other storage sites, hydroelectric development would prevent irrigation of higher elevation land with the portion of the storage used for power generation. Estimated average generation is 2,000 KW.

Conant Creek - Sec. 25, T. 8 N., R. 43 E. - A 150-foot high, 1,300-foot long dam could store 40,000 acre-feet at 5,600 feet elevation. The water available annually from Conant Creek is estimated to be 30,000 acre-feet. Provisions for dry years may reduce this to 20,000 acre-feet. Additional water could be diverted from Falls River into a 15 mile canal. An alternate water source would be Bitch Creek from a diversion at the 6,050 feet elevation level, again through a 15 mile canal. Approximately 400 feet of head could be developed in this canal system. An alternative to diversion from the Falls River, is a diversion from Boone Creek at 6,200 feet elevation, three miles upstream from the mouth. A four mile canal could provide a 250-foot head. Preliminary estimates suggest 30,000 acre-feet could be available from a Boone Creek/Squirrel Creek diversion. A dry year estimate would be 20,000 acre-feet.

Squirrel Creek - Sec. 1, T. 8 N., R. 45 E. - A 280-foot high, 3,300-foot long dam could store 130,000 acre-feet at 6,400 feet elevation. The water source would be Falls River through a 240-foot lift pumping plant and a 10 mile canal originating just below the Yellowstone National Park boundary, and 30,000 acre-feet, in most years, through a four mile canal from Boone Creek.

Squirrel Meadows - Sec. 9, T. 47 N., R. 118 W. (Wyoming survey origin) - A 50-foot high, 1,200-foot long dam could store 10,000 acre-feet in Wyoming at 6,400 feet elevation. Five dikes, about 20 feet high and 500 feet long, would also be needed at this site. The water source would be Boone Creek via a five mile canal.

Boone Creek - Sec. 35, T. 9 N., R. 45 E. - A 290-foot high, 2,800-foot long dam could store 80,000 acre-feet at 6,320 feet elevation. The water source would be Falls River through a 160-foot lift pumping plant and a 10 mile canal originating just below the Yellowstone National Park boundary. Approximately 30,000 acre-feet would be available in most years from the Boone Creek drainage. A generating plant could be located one and one-half miles downstream from the dam at the confluence of Boone Creek with the Falls River. This would develop 520 feet of head between elevations 6,320 and 5,800 with a full reservoir. Approximately 3,000 KW would be the average generation using only Boone Creek water. To use reservoir water for power generation would generally prevent its use for irrigation on higher land. Without the dam, about 400 feet of head could be developed with a three-mile conduit.

JY Ranch - Sec. 24, T. 9 N., R. 44 E. - A 170-foot high, 3,300-foot long dam on Rock Creek, a tributary to Robinson Creek, could store 50,000 acre-feet at 5,800 feet elevation. If the dam was raised 40 feet the storage capacity would be increased roughly an additional 30,000 acre-feet for a total of 80,000 acre-feet. The water source would be Falls River through a 12 mile canal starting just below Sheep Falls. Alternately, if water was taken three miles downstream at the Yellowstone Canal inlet on the Falls River, an 80-foot pump lift would be needed. Geologic features at the damsite may not be favorable and would need further analysis, as is the case for all sites reviewed in this report. Geologic studies one mile downstream, just below the mouth of Porcupine Creek, reported unfavorable findings (1961 Snake River Basin Summary Report of USBR/COE site 68, p. 7-214).

Howell Ranch - Sec. 24, T. 9 N., R. 44 E. - A 130-foot high, 3,700-foot long dam on Rock Creek could store 30,000 acre-feet at 5,720 feet elevation. The water source would be Falls River at the Yellowstone Dam diversion, two miles above the National Forest boundary. The inlet canal would be 10 miles long.

Robinson Creek - Sec. 3, T. 9 N., R. 44 E. - A 300-foot high, 2,000-foot long dam could store 70,000 acre-feet at 5,800 feet elevation. Approximately 20,000 acre-feet are available from Robinson Creek, and 5,000 acre-feet might be available via a three-mile canal from Fish Creek. Additional water could be made available through a canal system from the Falls River. The easiest canal route from the Falls River would be an over-flow tunnel one mile long from a reservoir at the JY Ranch site, so facilities at Robinson Creek should be constructed in conjunction with this project.

Park Lake - Sec. 10, T. 9 N., R. 45 E. - A 220-foot high, 2,200-foot long dam at 6,200 feet elevation could store about 40,000 acre-feet. The site is on Upper Rock Creek near the southwest corner of Yellowstone National Park. The water source would be Falls River just below the Yellowstone National Park boundary. A 12 mile canal would be needed plus a pumping plant to fill the top 40 feet of the reservoir.

Moose Creek - Sec. 13, T. 13 N., R. 44 E. - A 140-foot high, 1,000-foot long dam at 6,640 feet elevation could store 60,000 acre-feet. The water source would be Henrys Fork through a six-mile canal with a pump lift of 250 feet. A narrow constriction at the end of a large valley provides a good reservoir site for a low, short dam. However, the Henrys Fork is well regulated by Island Park Reservoir. Island Park Reservoir is below the point at which water would be taken from the Henrys Fork so the Moose Creek Reservoir site would have few water-storage benefits.

Ashton Dam Enlargement - Sec. 28, T. 9 N., R. 42 E. - This enlargement would be a 38-foot rise in the water surface for a total height of 94 feet at the dam. Although the proposed dam would be 1,000 feet long, a couple of dikes totaling an additional 4,000 feet would be needed. The reservoir storage could increase 40,000 acre-feet, and the reservoir surface area would change from 400 acres to 1,800 acres. With the increase in surface area, there would be an additional water loss to evaporation of approximately 4,000 acre-feet. The new water surface would be at 5,192 feet elevation with the dam crest at 5,200 feet. The benefits of this project are storage for flood control on the lower Henrys Fork, and power generation (90 percent of the benefits). The current 5,800 KW hydroelectric plant generating 33,000 MWH could be replaced with a 12,000 KW generating plant. This would generate a total of 70,000 KWH annually or an average of 8,000 KW. (See report, Upper Snake River Basin, Volume I, Summary Report, USBR/COE, 1961, p. 7-28.)

Teton - Sec. 30, T. 7 N., R. 42 E. - A 300-foot high dam on the lower Teton River could create the largest reservoir within the basin. The site is located about two miles upstream of the mouth of the canyon and about 15 miles northeast of Rexburg. Active storage could be 200,000 acre-feet with 315,000 acre-feet total-storage. The reservoir would extend 17 miles up to the mouth of Bitch Creek and a little over two miles up Canyon Creek. The reservoir site is a narrow but gently descending canyon incised through a rolling plateau used largely for dryland and sprinkler irrigated agriculture. A hydroelectric plant located at the dam would have 295 feet maximum head. The average generation could be about 14,000 KW (123,000 MWH). Because of water releases from the reservoir for seasonal uses, the probable average generation is reduced to 8,000 KW (73,000 MWH) from an installed capacity of 22,000 KW. The movement of a large amount of Falls River water into the Teton basin for storage at an off-stream site such at Bitch Creek could considerably improve the power benefits at the Teton site.

One primary benefit of the Teton Reservoir site is that Upper Teton River water users (about 7,000 acres in Teton County) could continue to divert the upper river flows later into the summer. The Lower Teton River users have an earlier priority for natural flow water rights which could be provided by Teton Reservoir storage water. Natural flows then, by exchange, could be used above Teton Reservoir after July 1. An alternative use of Teton Dam could be to provide the head for a valley-wide gravity irrigation system for the lower Henrys Fork including the Egin Bench. This could conserve water, but in turn, would prevent ground-water recharge.

Teton: Recent Reappraisal Summary - The U.S. Bureau of Reclamation has recently completed a reappraisal of the Teton Reservoir project. Re-analysis has been set up to allocate water yields as follows:

41,000 ac-ft for mitigation flows - resident fish
24,000 ac-ft to enhance trumpeter swans
<u>20,000</u> ac-ft for supplemental irrigation
85,000 ac-ft of total yield.

Water bank water or the use of supplemental ground-water wells were not added to increase total water yield as was done in the original project.

The allocation of construction cost in million dollars was:

Irrigation	52
Power	34
Flood Control	49
Swan Flows	28
Recreation	5
Total	168

Interest during construction would be an added cost. The irrigation portion of the project included 25 million dollars to provide distribution to the Enterprise, East Teton and Canyon Creek Canals. Since Teton Reservoir water would belong to the water bank in exchange for natural flows, the project could probably be constructed using only the smaller Canyon Creek Canal. Of the 168 million dollar construction cost, 137 million dollars is the current estimate for the dam, spillway, powerplant, river outlet works, mechanical items for structures, lands and rights, and clearing of lands.

Fish and wildlife mitigation for the original project included 17,000 acres to be acquired, or set aside, which has been done. In addition, a minimum pool of 100,000 acre-feet was to be provided for fishery use. Hatchery facilities were to be constructed to rear trout and kokanee for release into the reservoir and river below the dam. Thirteen existing diversions below the dam were to be screened and the original proposal was to provide 300 cfs of stream flow with 150 cfs during dry years. In the reappraisal the U.S. Fish and Wildlife Service requested a mitigation stream flow of 450 cfs below the dam.

Fifty-two million dollars allocated to irrigation with zero interest and a 50-year repayment schedule, would require an annual repayment of $1,040,000. For an average annual yield of 20,000 acre-feet, the annual cost per acre-foot would be $52.00. If the cost allocation for irrigation was cut in half by deleting distribution facilities, and the amount of water allocated to irrigation was doubled, the annual cost per acre-foot would be $13.00 plus $2.70 for operation and maintenance costs. On the lower Henrys Fork where exchange water from main-stem Snake River storage has been available at a cost of $2.95 per acre-foot, the $15.70 ($13.00 + $2.70) per acre-foot is not competitive. Project analysis and cost of construction make new storage water much more costly. The allocated cost originally authorized by Congress for the failed Teton Dam was $2.21 per acre-foot including operation and maintenance (about $1.50 for construction costs only).

Warm River - Sec. 14, T. 9 N., R. 43 E. - A dam on the Henrys Fork six miles northeast of Ashton, just below the mouth of the Warm River could raise the water about 220 feet and create a reservoir with an active capacity of 75,000 acre-feet (140,000 acre-feet total capacity). Water would be backed up the Henrys Forks seven miles to the top of Lower Mesa Falls. This site could be used for power generation. The average annual generation would be 22,000 KW (190,000 MWH) with a 30,000 KW powerplant. A dam that raised the water 150 feet instead of 220 feet would back water up to the base of Lower Mesa Falls but would have considerably less water storage potential and an average annual generation of about 15,000 KW (130,000 MWH).

Driggs/Tetonia - A 43 feet high, 6,500 feet long dam on the upper Teton River near Driggs, (Sec. 13, T. 5 N., R. 44 E.), could store 50,000 acre-feet of which 35,000 acre-feet would be usable. The water storage elevation would be 6010 feet. A 140-foot high, 1200 feet long dam at the lower

Tetonia site, (Sec. 3, T. 6. N., R. 44 E.), could store 590,000 acre-feet at 6010 feet elevation, although the reservoir would flood a considerable area. A powerhouse could be built at the dam with a head of 140 feet. Average generation would be 4,000 KW if storage water is used on lands below the outlet elevation of the reservoir. The Tetonia site might be used with a lower height dam of 66 feet for hydroelectric production. It would generate about 18,000 MWH annually or an average of 2,000 KW with a 4,000 KW generator. The upper water level would be at 5930 feet elevation. Geologic studies for a large reservoir at this site disclose potential reservoir leakage. Correction of this problem would impose significant cost (USBR, 1961).

Marysville Headworks - Sec. 35, T. 9 N., R. 44 E. - A 120-foot high dam on the Falls River, above the site of the Marysville Canal diversion, could store 38,000 acre-feet and use about three miles of the Falls River. The Yellowstone Canal diversion works would be one-half mile upstream. A 140-foot high dam would raise the elevation to 5740 feet, store 56,000 acre-feet, and back water up to the Yellowstone Dam. The elevation of this reservoir would allow its use as a gravity irrigation system for much of the lower dryland in the Drummond-Lamont area.

Buffalo River Hydro - Sec. 20, T. 13 N., R. 44 E. - This 17,000 acre-feet site is on the upper Buffalo River six miles above its mouth. A 1400-foot long dam could raise the water level 100 feet. A tunnel about 0.6 mile long in Sec. 35, T. 13 N., R. 44 E. would move Split Creek into the upper Buffalo Creek drainage. This reservoir generally would be used for power generation. Average annual generation may be near 2,000 KW although the installed capacity could be twice this amount. The springs that form the beginning of a large part of the Buffalo River would be inundated to a depth of 50-75 feet. There is some concern that water pressure would slow the spring flow and shift part of the outflow to a different location. This project is reviewed in Water Power Resources of Idaho Under the Ponds Lodge heading, p. 67.

2. Ground-water Use and Ground-water Exchange

The selective direct use of ground water in the lower Henrys Fork area from St. Anthony to the mouth of the basin would allow the diversion of the Henrys Fork onto land now served by the Falls River. A gravity diversion at Ashton Dam (elevation 5,150 feet), could move water into the Enterprise and Falls River Canals. In order to serve higher lands in the Ashton area, the Henrys Fork could be diverted near the settlement of Warm River at elevation 5250 through a pumping plant with a lift of 250 feet. The Falls River water, in turn, could be diverted in the vicinity of the Yellowstone Canal and could be used in the Drummond/Lamont areas.

3. Ground-water Storage

Further study needs to be given to the potential of groundwater recharge for local use. The area that appears to have the best groundwater recharge potential is the Marysville-Grainville-Squirrel-France-Lamont area west of the National Forest boundary. In this area, material directly below the soil profile is mapped as gravel and outwash from the east mountains. The bedrock material is unknown, although in many areas it appears to be rhyolite, a less porous rock than basalt. Thus, it appears recharged groundwater could largely stay in the area for later use. Further groundwater studies are needed.

This study also should cover the Chester-Drummond area south to the Teton River as well as the south side Teton River Plateau areas from Moody Creek to Canyon Creek and east to the Teton River. Much of this area appears only to have the less porous felsic rock below the soils but, again, a detailed study would be helpful to further define local differences and opportunities for ground-water recharge.

4. Weather Modification

Cloud seeding has been successful in increasing winter precipitation. The success rate appears to be significant in mountainous terrain much like the upper reaches of the Henrys Fork Basin. However, weather modification programs are generally not successful increasing precipitation during drought periods since storm clouds are not present for seeding. Cloud seeding in normal years can provide more water for carry-over into a drought cycle. An increase in precipitation of 10 to 15 percent during a drought period appears low, however, the increase in runoff could be higher if the soil profile was saturated or became saturated as a result of induced precipitation. Consequently, even in an impending drought situation, the seeming small amount of additional precipitation does make a difference.

The implementation of a weather modification program should be long-term. One consideration for cloud seeding is the usefulness of winter and early spring snow. In the winter or early spring additional runoff generated by cloud seeding would generally occur over frozen ground and could be stored in basin reservoirs. Late spring rains, much of the time, percolate into the groundwater system and are greatly delayed in returning to streamflow. This consideration accentuates the importance of starting cloud seeding early in the water year, probably in November.

5. Rental Pool

The rental pool, also known as the water supply bank, generally consists of assigned irrigation storage water space in Jackson Lake Reservoir, Palisades Reservoir and American Falls Reservoir. This storage water may be used by Henrys Fork basin irrigators through an exchange for natural flow which would normally pass downstream to earlier priority water-right holders. The exchange of water is limited to available stream flow not used in the area. Rental pool water is the most economical water for new uses, if it can be made physically available. The current price is $2.95 per acre-foot used, of which $0.75 goes to Water District #1, Snake River and Tributaries above Milner, for administering the rental pool.

6. Water Conservation

In the Henrys Fork basin, water conservation applies principally to irrigation, since irrigation is the primary off-stream use of water. The greatest on-farm water losses are from deep percolation or seepage below the root zone, especially in the sandy subsoil of river bottom areas. End-of-field runoff is a much smaller loss and, of course, can be immediately reused by a lower diverter.

With sprinkler systems crop yields may be significantly increased since over watering is reduced. Labor expenditures for irrigation may also be reduced or reallocated. A conjunctive use strategy to maximize water use in the basin would use surface water in "good" water years. Ground water could be used to supplement supplies during low water years. The continued reliance on surface water throughout much of the basin will ensure adequate recharge to the aquifer for local needs.

Water conservation has been a focal point in many different water-use programs. Recently, in the Drought Assistance Act of 1988, it was stated the Secretary of Interior is to "perform studies to identify opportunities to . . . conserve water supplies available to Federal reclamation projects." In the Reclamation Reform Act of 1982 (regarding a change of acreage limitation), a lesser discussed section of the act states:

> "(a) The Secretary (of Interior) shall . . . encourage the full consideration and incorporation of prudent and responsible water conservation measures in the operations of non-Federal recipients of irrigation water from Federal reclamation projects, were such measures are shown to be economically feasible . . . ."

"(b) Each district that has entered into a repayment contract or water service contract . . . shall develop a water conservation plan which contain definite goals, appropriate water conservation measures, and a time schedule for meeting the water conservation objectives."

"(c) The Secretary is authorized and directed to enter into memorandums of agreement with those Federal agencies having capability to assist in implementing water conservation measures to assure coordination of ongoing programs. Such memorandums should provide involvement of non-Federal entities such as States, Indian tribes, and water user organizations to assure full public participation in water conservation efforts" (underlining added).

In answer to subsection B of the above act and as an example of what can be done in water conservation measures, an excerpt follows from a letter of the Falls Irrigation District of American Falls, Idaho (Michaud Flats) to the U.S. Bureau of Reclamation.

As you will see below, the District (since 1980) has not used water in excess of 2.07 acre feet per irrigable acre:

AVERAGE WATER USE PER IRRIGABLE ACRE
in Acre-Feet

1980 - 1.73
1981 - 2.07
1982 - 1.76
1983 - 1.35
1984 - 1.59
1985 - 1.82

Average 1.72

One definite advantage we have over other organizations is being an almost total (we have one or two small acreages who still use flooding to irrigate pastures) sprinkler project. Our water, when put upon the land, stays there. We do not have to contend with part of the delivered water running off the end of the field, so this does entail less water needed to be applied to acquire the water crops need for proper growth.

There are two acre feet of water per acre allowed each wateruser for normal usage which is paid for in the O&M assessment. Any water used in addition to this amount is classed as excess water. The first acre foot of excess water is charged at the same rate as the first two in the allotment. The second acre foot of excess is charged at one and a half times the price of the first three acre-feet. These excess water charges encourage our waterusers to conserve as much as possible by improving their equipment and using it more efficiently.

We also have a very strict water measurement procedure when delivering water to our waterusers. All the District's delivery points are locked and operated only by District personnel. This enables the District to have a more controlled water delivery system and equality of charges to all waterusers.

We are using a computerized water recording system where the ditchriders put the delivery into a calculator and later feed it into the computer. Written records are also kept to confirm the computer printouts. The computer can compile and organize the records quickly so that, when calling, waterusers are provided a faster and more accurate status of their water accounts. This helps them use their water more wisely and efficiently and encourages conservation in their operations."

Recommended Action

1. Encourage water conservation and the use of water bank water in lieu of new impoundments as sources of additional water. Use both yearly leases and develop innovative long-term leases. Exchanges with natural flow rights will be the main method of implementation in the Henrys Fork basin.
2. Ground-water wells and more efficient irrigation systems are additional water sources that should be considered. The benefits of large water conservation actions must be carefully weighed against the ground-water recharge benefits associated with current practices.
3. Study the availability of the ground-water resource in the plateau areas east of St. Anthony and in the Canyon Creek area.
4. Study off-stream reservoir sites for Falls River and Teton River water. (Uses would be irrigation of Drummond-Lamont dryland farmed area and similar plateaus, plus power development, limited flood control, and recreation.)
5. Encourage the use of surface water during high and average flow years in order to promote regional ground water recharge; during low flow years a partial switch to ground water use is encouraged.
6. Amend new ground-water license/transfer procedures to allow irrigators that transfer from a surface water source to a ground-water source to keep the surface water priority date for a portion of the water transferred if certain conditions are met.
7. Specific aquifer recharge project areas may be helpful if set aside for use during high and average runoff seasons.
8. For any surface water development, if the environmental consequences are acceptable, encourage reservoir location in the upstream or upper plateau areas in order to allow for water use in these areas.
9. Continue to reserve the Teton Dam site for future use as a major water storage project. Release the reservation of the Warm River Dam Site.
10. Set up a weather modification study in the upper basin with a companion study to determine resulting increased surface runoff.
11. Water quality, water yield and water development opportunities should be a planning consideration for all regulatory and management agencies in the basin.
12. Seek legislative change which would provide incentives for water conservation. Saved water must somehow benefit the entity effecting the savings.

Sources

Allen, R.G. and C.E. Brockway. *Estimating Consumptive Irrigation Requirements for Crops in Idaho, Appendix E.* Idaho Water and Energy Resources Research Institute: Moscow, ID 1983.

Annual Report, Water District 1, Snake River and Tributaries above Milner, Idaho. Idaho Department of Water Resources. Selected years including unpublished data for recent years.

Bond, John G., et al. *Geologic Map of Idaho.* Idaho Department of Lands, Bureau of Mines and Geology: Moscow, Idaho. 1978.

Columbia River Water Withdrawal Environmental Review Appendix H - Agricultural Data Part I Test - Tables. U.S. Corps of Engineers, Portland District. May, 1980. p. 25.

Filler, J.R. *An Inventory of Potential Offstream Reservoir Sites in the Upper Snake River Basin, An Appendix to A Preliminary Appraisal of Offstream Reservoir Sites for Meeting Water Storage Require-*

ments in the Upper Snake River Basin. Moscow, Idaho: Idaho Water Energy Resources Research Institute for U.S. Army Corps of Engineer, Walla Walla District, February, 1981.

Ham, Herbert M. *Replacement Groundwater Supply First Phase - Lower Teton Division Teton Basin Project, Idaho.* U.S. Bureau of Reclamation, Region I, Boise, Idaho. 1968.

Haskett, Gordon. *Ground-Water Geology of the Rexburg Bench Second Phase, Lower Teton Division Teton Basin Project, Idaho.* · U.S. Bureau of Reclamation, Region I, Boise, Idaho. 1972.

Haskett, Gordon, Alan Jensen and David Gangwer. *Groundwater Studies Henrys Fork, Teton River Area Fremont and Madison Counties, Idaho.* U.S. Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho. 1977.

Kirkland, Larry A., C.C. Warnick and L.F Heitz. *Inventory of Offstream Reservoir Sites in the Upper Snake River Basin.* Moscow, Idaho: Idaho Water Research Institute for U.S. Army Corps of Engineers, Walla Walla District, November, 1979.

Lindholm, G.F., S.P. Garabedian, G.D. Newton and R. L. Whitehead. *Configuration of the Water Table and Depth to Water, Spring 1980, Water-Level Fluctuations, and Water Movement in the Snake River Plain Regional Aquifer System, Idaho and Eastern Oregon.* U.S. Geological Survey. Atlas HA-703 (map). 1987.

Madison County, Idaho Water-Related Land use - 1975. Idaho Department of Water Resources, Boise, Idaho. 1978.

U.S. Department of Interior, Bureau of Reclamation, Region 1, Boise, Idaho and Army Corps of Engineers, Walla Walla District, Walla Walla, Washington. *Upper Snake River Basin Wyoming-Idaho-Utah-Nevada-Oregon. Vol. I, Summary Report.* Boise, Idaho: 1961. (Index of Projects Investigated and Not Accepted, Chapter 7, p. 213 and other sections.)

U.S. Department of Interior, Bureau of Reclamation, Region 1. *Teton Basin Project Idaho-Wyoming Reconnaissance Report.* Boise, Idaho: October, 1961.

Warnick, C.C. and others. *A Preliminary Appraisal of Offstream Reservoir Sites for Meeting Water Storage Requirements in the Upper Snake River Basin.* Moscow, Idaho: Idaho Water and Energy Resources Research Institute for U.S. Army Corps of Engineers, Walla Walla District, February, 1981.

"Water Transfer and Marketing Working Paper." *Upper Snake River Basin Optimization Study Idaho-Wyoming - Information Update.* U.S. Bureau of Reclamation in Cooperation with the Idaho Department of Water Resources, Boise, Idaho. December, 1909. 52 p.

Wytzes, Jetze. *Development of a Groundwater Model for the Henrys Fork and Rigby Fan Areas, Upper Snake River Basin, Idaho.* Idaho Water and Energy Resources Institute: Moscow, Idaho. 1980. pp. 26-27. (Note: Calculated acres not available for all mutual irrigation companies.)

Young, L.L. and J.L. Colbert. *Waterpower Resources of Idaho.* U.S. Department of Interior, Geological Survey, Conservation Division, Open-File Report 1965.