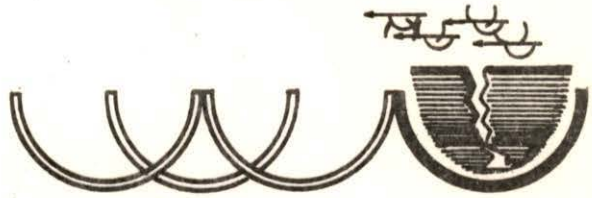

FISH & WILDLIFE RESOURCE LOSSES

TETON DAM FAILURE

AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

United States Department of the Interior

FISH AND WILDLIFE SERVICE

AREA OFFICE - IDAHO AND OREGON
4620 OVERLAND ROAD, ROOM 238
BOISE, IDAHO 83705
FTS: 554-1960 / COMM: 208/384-1960

June 1, 1977

MEMORANDUM

To: Regional Director, Bureau of Reclamation
Boise, Idaho

From: Area Manager
Boise, ID

Subject: Teton Dam Failure Fish and Wildlife Damage Assessment and Compensation Plan

The enclosed report is submitted in accordance with your September 9, 1976, memorandum requesting a long-range fish and wildlife plan describing permanent work that would be necessary with either a dam rebuilt or a no-dam rebuilt situation. This report was prepared by the U. S. Fish and Wildlife Service's Ecological Services Field Office in Boise, Idaho, with technical assistance from the Idaho Department of Fish and Game. We appreciate the efforts of those who contributed to our effort, especially to your Environmental Services staff and to the State Office and Regions V and VI personnel of the Idaho Department of Fish and Game.

This report documents fish and wildlife losses resulting from the Teton Dam failure and recommends restoration measures that partially compensate for those losses. The information is intended to substantiate a request to Congress for funding fish and wildlife rehabilitation measures.

Philip B. Aus

Philip B. Aus

Enclosure

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FISH AND WILDLIFE RESOURCE LOSSES

Caused by Failure of Teton Dam - Idaho

Rehabilitation, Mitigation and Compensation Plan

Report Prepared by

Richard L. Nadeau, Project Leader
R.L. Van Wormer, Wildlife Biologist

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FOREWORD

This is a report describing the fish and wildlife resource losses caused by the flood resulting from the failure of Teton Dam. It also identifies measures necessary to partially replace those losses. The report was prepared by the U.S. Fish and Wildlife Service, to be presented to Congress by the Bureau of Reclamation for special project funding.

This study evaluates the short term and long term losses directly attributable to the flood and those losses indirectly attributable to flood related reclamation and restoration work such as debris removal from river channels, bridge and road replacement and land clearing in the months following the flood.

The proposed measures are designed to replace irretrievable losses immediately. The measures would lessen long term environmental, fish and wildlife and related economic impacts that would occur and would establish a basis of fish and wildlife habitats with some potential for recovery.

11.21.856

ABSTRACT:

On June 5, 1976, the Teton Dam broke, sending a wall of water, gravels and debris throughout the upper Snake River valley and the Teton, Henry's Fork and Snake River drainages, killing fish and wildlife and destroying or severely damaging their habitats.

Fishery losses include total loss of one reservoir and its fishery, irretrievable loss of 12 miles of blue ribbon trout stream and fishery of national significance, 50 to 60 percent habitat loss of 60 miles of self-sustaining fishing streams and sloughs, and short term fish losses and limited habitat losses on 100 miles of river. Without extensive restoration, an additional 46 miles of stream habitats and fisheries will be lost. Also, there has been an expansion of rough fish populations into 45 miles of previously uninfested streams. These habitat losses will result in an estimated loss of 12,215,000 man-days of fishing during the life of the project, valued at 43.5 million dollars.

Big game losses include 105 to 130 mule deer and white-tailed deer, and four moose. Habitat losses include 1,260 acres of big game habitat to flood forces, 3,380 acres of habitat to restoration measures. These habitat losses will result in an estimated loss of 2,560 man-days of hunting over the next five years, valued at $44,000.

Upland game losses include destruction or displacement of all ground dwelling upland birds and rabbits; the loss of 2,660 acres of upland game habitat, flood force damage to over 62,000 acres of upland game habitats that will recover in from 5-15 years. These habitat losses will result in an estimated loss of 35,400 hunting days over the next 50 years, valued at $350,000.

Waterfowl and shorebird losses include 770 goslings, 8,300 nested eggs and ducklings, approximately 5,000 shorebirds, destruction of approximately 2,100 acres of waterfowl habitat by flood forces (does not include area used by both waterfowl and big game and recorded under big game losses), loss of approximately 3,000 acres of habitat by debris clearing. These habitat losses will result in a loss of 10,000 duck and 1,400 goose hunter-days, valued at approximately $6,300,000.

Measures needed to restore fisheries losses are stabilization of soils in Teton Canyon, fisheries and stream rehabilitation studies, construction and rehabilitation, trash fish eradication, fish stocking and the construction of a fish hatchery to meet fish stocking demands. Estimated total costs are $14,500,000, plus 100 year amortized O&M costs for the hatchery.

Compensation for big game habitat losses requires off-site acquisition of 2,840 acres of land, restoration and O&M for 50 years. Estimated total costs are $1,936,000.

Upland game, furbearers, and non-game losses will be compensated for with the waterfowl and fisheries compensation measures.

Compensation for waterfowl losses require acquisition of 6,423 acres, restoration and O&M. Estimated total costs are $4,946,200.

Senate Bill S.1202, if passed, would make 6,000 acres of Federal lands available to farmers who lost their lands in the Teton flood. Compensation for wildlife which will be lost on those 6,000 acres would require acquisition of 5,500 acres and development and O&M for five years. Total estimated costs are $2,878,000.

Estimated total compensation costs are $24,260,000, plus O&M with Senate Bill S.1202 and $21,138,200, plus O&M without Senate Bill S.1202.

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I. INTRODUCTION

A. Area Description

The Teton River is located in the southeastern portion of Idaho. It originates on the west slope of the Teton Mountains in Wyoming and flows westerly to its confluence with the Henry's Fork River just south of St. Anthony, Idaho (Figure 1, Area Map).

The Teton River drains an area extending from the high wooded plateau south of Yellowstone Park to the western slopes of the Teton Mountains and the north slopes of the Big Hole Mountains. This is summer range for mule deer, elk, and moose.

The upper section of the river meanders through a broad flood plain that has been developed for agricultural use. The river then drops off into the Teton Canyon where the depth becomes progressively greater as the river moves downstream to the area of the Teton Dam. Before the dam construction, the Teton River within the canyon contained spawning areas, highly productive riffles and runs, and some large holes that maintained an excellent native cutthroat trout population. In late fall, the canyon walls and surrounding lands became the wintering grounds for the big game herds that summered upstream. Here, below the barren agricultural flats, they found food and shelter from the intense winters that are common to the area. The more severe the winter, the further down the canyon they moved. The river and surrounding riparian vegetation in the canyon supported a good waterfowl population, furbearers, and some grouse. The area was a haven for non-game passerine birds and provided raptor nesting habitat.

After leaving the canyon, the Teton River once again moves out onto a broad flat flood plain that has been developed into irrigated farmland. As the river leaves the canyon, its energy is expended forming meanders, deep holes and cut bank areas that once supported a blue ribbon cutthroat fishery. The river then separates forming the North and South Forks. Both tributaries have numerous irrigation diversions and the quality fishery has been declining because of reduced flows, irrigation return flow sedimentation and habitat destruction. However, because of deep holes and patches of willow cover, there were still good numbers of large rainbow trout, cutthroat trout and whitefish before the dam failure.

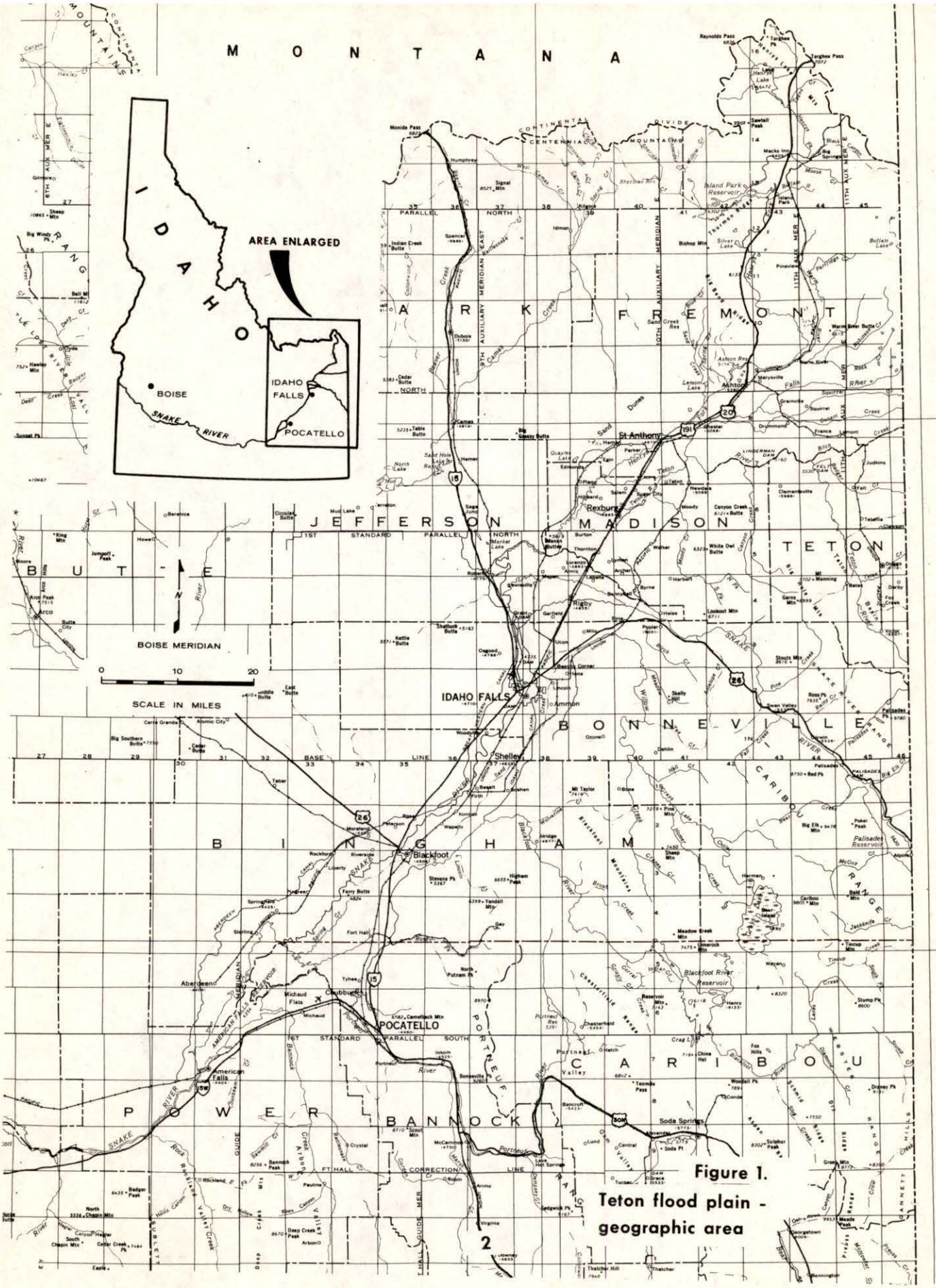
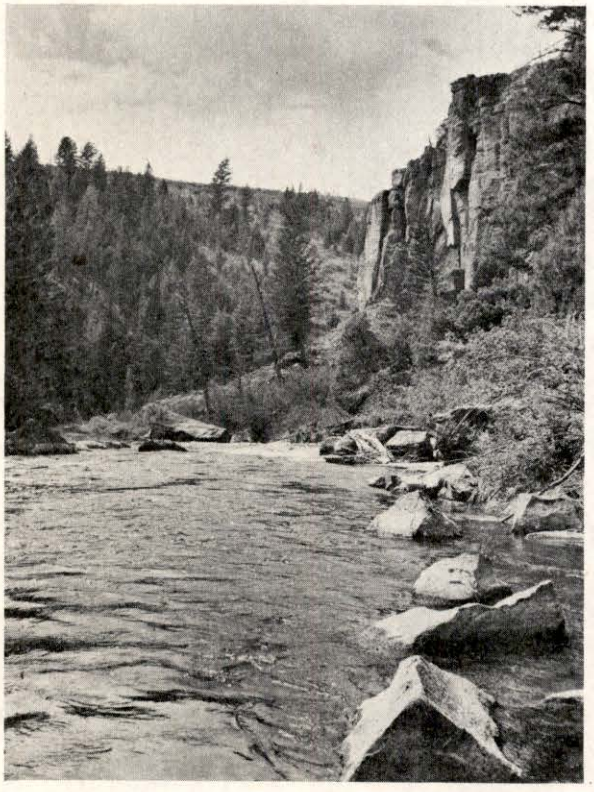


Figure 1.

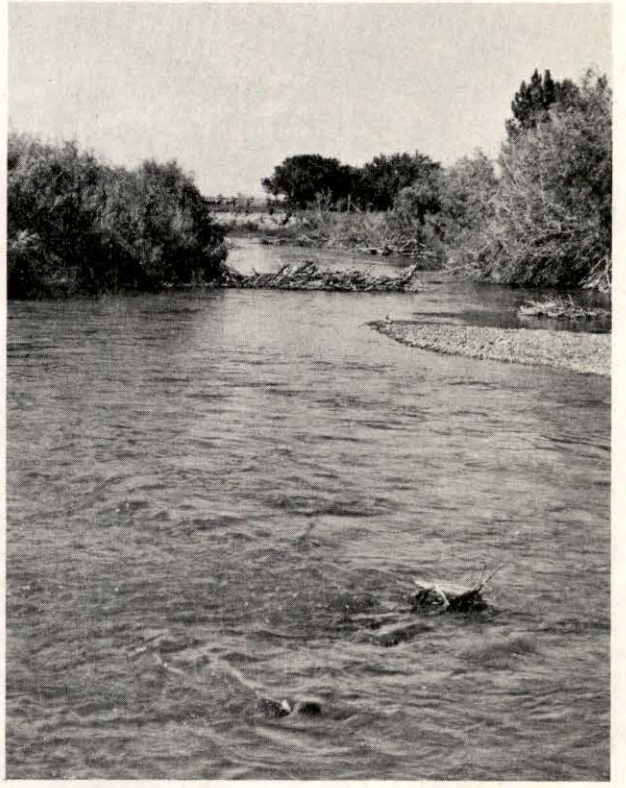
Teton flood plain - geographic area

Upper Teton Canyon - above the Teton Dam site (1961).

Lower Teton Canyon - directly below Teton Dam site.



Teton Canyon in reach inundated by Teton Dam reservoir (1961).



North Fork Teton River Near Junction of South Fork Teton River, 1961.

Wetlands, riparian vegetation, and in some locations, wooded bottomlands provided food, cover, and nesting areas for waterfowl, stream bank dens, food, and cover for furbearers, cover and food for rabbits, and food and nesting habitat for doves, grouse, and many non-game birds. The fence rows, ditch rows, and other vegetated areas of the agricultural lands through the flood plain supported populations of pheasant, cottontail, and other upland game species. Some deer and an occasional moose were present along the river near the confluence with the Henry's Fork River.

The Henry's Fork flows in a southwesterly direction from its headwaters in the Island Park country. After leaving the heavily timbered upper reaches, the river breaks out onto the broad upper Snake flood plain. Before the flood, dense vegetation along the river provided habitat for big game such as moose, and deer, as well as for furbearers, dove, grouse, pheasant, rabbit, and many other non-game birds and mammals. Many sections along the meandering river contained highly productive wetlands and sloughs which provided nesting and resting areas for waterfowl and good cover for furbearers and non-game animals. The river channel of the Henry's Fork River through the lower reaches had problems with siltation in many areas before the Teton Dam failure occurred. The siltation had degraded the fish habitat and perpetuated increases in undesirable non-game fish. However, many areas along the lower Henry's Fork River and some of its tributaries such as Warm Slough, Texas Slough, and Bannock Jim Slough, supported good populations of rainbow trout.

The South Fork Snake River below Lorenzo and the main Snake River between the confluence of the Henry's Fork and South Fork Snake River meander through a flat flood plain similar to that surrounding the lower Henry's Fork. From Lorenzo to Roberts, large tracts of stream bottom upland vegetation and wetlands provided good habitat for waterfowl, furbearers, rabbit, dove, and a few deer. The intermittent islands provide excellent shore and marsh bird nesting habitat and support a great-blue heron rookery. Because of the diversity of open grassy pockets in the dense vegetation on islands surrounded by river channels, the area supports an excellent forest nesting raptor population which includes osprey, goshawk, and red-tailed hawk. Many non-game birds and mammals also are attracted to the good cover provided through this area. As on the Henry's Fork River, siltation had been a major limiting factor to the trout populations even before the flood disaster. The Dry Beds, Spring Creek, and some sections of the main river that had not been silted in provided good fish habitat and were highly productive. The irrigated farmland adjacent to the river provided good habitat for pheasant, dove, rabbit and some Hungarian partridge.

Roberts Slough near the town of Roberts, Idaho, is one of the better shorebird and marsh bird nesting areas in this section of Idaho.

The Snake River from Idaho Falls to Blackfoot flows through rich farmlands. A number of large irrigation structures reduce summer flows. Channelization for highway right-of-ways has significantly reduced the fishery in many areas through this stretch of river. Streambank clearing and intense farming practices have badly reduced wildlife habitats. The Snake River from Blackfoot to American Falls Reservoir flows through the upper reaches of the Fork Hall bottoms that were, at one time, one of the richest wildlife areas in Idaho. The lower reaches of the bottoms and the adjacent Big Springs Meadows are highly productive waterfowl and pheasant nesting areas. The tree covered islands support great-blue heron, black-crowned night heron and egret rookeries. Forest nesting raptors are common. Vegetation in the river bottom supports high populations of rabbit, furbearers, dove, and non-game species, and some deer. Pheasants survive the hard winters of the area in this heavy vegetative cover. Although the river has suffered from large populations of rough fish and some degree of silting, many areas still produce catchable trout.

B. Teton Dam Project Descriptions and Attributable Fish and Wildlife Losses

The lower Teton Division was authorized for construction on September 7, 1964, through P.L. 88-583, 88th Congress, S. 1123, 78 Stat. 925. It consisted of construction of an earthen dam whose function was to provide irrigation, flood control, power, fish and wildlife, and recreation. The dam was located approximately one mile below the mouth of Canyon Creek. The reservoir to be formed by the dam would extend approximately 17 miles upstream to the mouth of Bitch Creek.

Construction of the dam caused a near total loss of big game wintering range for deer and elk, loss of an excellent waterfowl production area, and destruction of furbearer, rabbit and other upland game habitats. Seventeen miles of blue ribbon trout stream and an excellent float boat fishery were destroyed.

C. Teton Dam Project Fish and Wildlife Mitigation Plan

To help compensate for the fish and wildlife resource losses, a cooperative plan was designed. The measures consisted of the following:

Fish hatchery facilities
Public streamside access
Minimum flows in Teton River
Fish screens on pumping plant
Acquisition of lands for wildlife at three locations
Development and management of these lands

To compensate for part of the fish losses, two hatchery raceways were to be installed at an existing hatchery to rear trout for stocking downstream from Teton Reservoir. Construction and operation of these facilities was to be carried out by the Idaho Department of Fish and Game with funds provided by the Bureau of Reclamation. In addition, public fishing access was to be acquired on selected reaches of trout stream in the vicinity of the Teton Basin Project. A minimum flow of 300 cubic feet per second was to be sustained in the Teton River downstream from the Lower Teton Dam. A fish screen was installed on the intake to the pumping plant at the dam.

To compensate for part of the wildlife losses, about 960 acres of land were to be acquired and fenced by the Bureau of Reclamation at designated points around the periphery of Lower Teton Reservoir. These lands were to be developed and managed by the Idaho Department of Fish and Game as big game winter range. In addition, about 15,000 acres of land were acquired in the Tex Creek area, about 30 miles south of the Lower Teton Reservoir in the Willow Creek drainage. Although this is on a different drainage and used by big game animals other than those being affected by construction of the Teton Reservoir, this area has a much greater potential for range improvement and increased carrying capacity than do any lands in the project vicinity.

In addition to the two areas above, a third area of 400 acres was purchased at Cartier Slough on the Henry's Fork River about 20 miles southwest of Lower Teton Dam. This area will serve as a wetland habitat area for waterfowl and fur animals.

All of the measures were completed except the hatchery raceways, public fishing access and development of the big game lands around the periphery of the Teton Reservoir.

These measures compensated for pre-flood fish and wildlife losses for a section of the canyon from the Teton Dam site upstream to approximately Bitch Creek and up the canyon walls to the expected high water reservoir pool mark. They do not compensate for additional losses in the canyon from the dam site to Bitch Creek caused by the dam failure or for downstream losses caused by the Teton Dam flood.

D. Reservoir Pool Area - Post-flood Status

Before the reservoir was filled, the canyon slopes had been logged and treated to remove vegetation up to the full pool elevation line. At the time of the dam failure, soils on the slopes in the canyons upstream from the dam had been thoroughly saturated and loosened. When the dam collapsed, the rapid evacuation of the water in the saturated slopes tended to pull the loosened soils causing extensive slumping, sloughing, and flow of debris (Figure 2).

At 19 sites, the slides extend into or across the river, forming dams which back up the river for as much as two miles (Figure 3).

Figure 2. Teton Canyon Above the Dam - Post-flood conditions.

Figure 3. Teton Canyon - Post-flood slides and dams above dam.

Figure 4. Teton Canyon Above Dam - Topsoil loss due to post-flood canyon wall slumping.

Entirely new conditions now exist in the former pool area. The 2,600 acres of big game winter range and upland habitat inundated by the Teton Dam pool prior to June 5, 1976, below elevation 5,301.5 ft. suffered the most extensive damage.

Because of the erosion, sloughing, massive land slides, the lack of vegetation, unstable stream conditions, flooded bottom lands, rates of vegetative recovery, etc., it is estimated that the pool area's potential for upland game habitat restoration is reduced by 80 percent over the next 15 to 25 years, and by 40 percent over the next 75-90 years.

In the seven and one-quarter mile reach from the uppermost elevation of the pool area downstream to Linderman Dam, there are 12 major slide areas. Three of these are extensive slides of three-quarters, one and three-quarters, and two and one-half miles in length. Ten of the slides have blocked the river and formed large pools behind them. Loss of topsoil ranges from 40 to 60 percent in most of the area (Figure 4). Some sites have a 100 percent loss caused from massive slides or erosion.

From Linderman Dam downstream four miles to Canyon Creek is a reach where the entire south wall has slid in, forming blockages with pools at seven different sites, and showing a 100 percent loss of top soils and vegetation. The north wall has approximately a 40 percent loss of soils.

From Canyon Creek downstream to the back waters of the existing Teton Dam pool area, the south wall is in fair condition with only three major slides and no blockages. The slopes in the five mile reach from the headwaters of the existing pool area to the Teton Dam are in about the same general condition as those in the reach just above it; however, the entire width of the flood plain is inundated. This is caused by a sill or footing at the dam (Figure 5). A total of approximately 60 percent of the soils were lost.

Figure 5. Teton Canyon Immediately Above the Dam - Canyon wall post-flood conditions.

Figure 6. Canyon Creek - Post-flood damage.

Slopes in Bitch Creek, and Canyon Creek, from the high water mark to the mouths, are a total loss. All of the soils in the canyon have sloughed into the bottom (Figure 6).

Since the soils are loose and fresh, the river continues to erode new channels and realign existing channels, causing heavy siltation. In the pool areas, the constant saturation at the bases of cliffs is causing sheet slumping to occur. In some instances, these slumps are continuing to extend above the reservoir pool level and are destroying big game winter range that was not affected by the original project. It is estimated that at least 100 acres are involved. Unless adequate restoration measures are taken, this total will increase. This slumping is also reducing the available canyon slope vegetable soils. The subsequent stream siltation is continuing to degrade the fish habitat. In the river's present condition, namely the large number of pools and great amounts of slack water, lack of spawning habitat, heavy silt movement, reduced potential for food organism production, and lack of riparian vegetation, it will not support a self-sustaining sport fishery and is a total loss for the entire 17 miles which were inundated. In addition, approximately three miles of Canyon Creek, a tributary to the Teton River within the pool area, is a total loss (Figure 6 and Figure 7).

Figure 7. Canyon Creek - Canyon wall slumping above reservoir line.

Besides its lack of ability to support a cold water fishery, this section of the river is now infested with a rapidly increasing population of rough fish. Two causes were the use of Utah chub and other rough fish as bait by fishermen in the reservoir prior to the dam failure and improved conditions for rough fish in the Henry's Fork, South Fork Teton, and main Teton Rivers due to flood damages. Some of these conditions include large expanses of shallow warm pools and flushing of sloughs where rough fish were known to occur.

Although the inundated slopes in the reservoir area were dewatered by the dam failure, the loss of soils, instability of the remaining regolith, and loss of vegetation have negated their value to wildlife until some type of restoration, either natural or managed, occurs. Even with managed restoration, the pool area's potential to support upland game and big game has been reduced 100% for the next 1-5 years, 80% between years 5 to 15, and 40% over the next 100 years. Without revegetation and other forms of extensive restoration, the slumping and erosion will continue to reduce these values.

Streambank erosion, inundation by mud slides, and loss of all riparian vegetation has totally destroyed fur animal habitat in the pool area. This habitat cannot be expected to recover until the river has stabilized and the riparian vegetation is re-established. The less disturbed areas (20 to 30%) may recover in 10 to 15 years. Badly disturbed areas will require 20 to 50 years to show any appreciable recovery as fur animal habitat. Many sites will never recover.

E. Post-flood Restoration Projects

Because of the immediate concern with the erosion and silting problem associated with the reservoir pool area canyon slope slumping, the U.S. Fish and Wildlife Service contracted the U.S. Forest Service, Intermountain Forest and Range Experiment Station to develop a revegetation program. This program was presented to Bureau of Reclamation and with the assistance of U.S. Forest Service was initiated in 1977. The aerial seeding portion has been completed, live shoots are being rooted, and hand planting is scheduled. It is anticipated that this program will help stabilize canyon bottom soils, reduce erosion, and start the recovery of parts of the canyon to wildlife habitat.

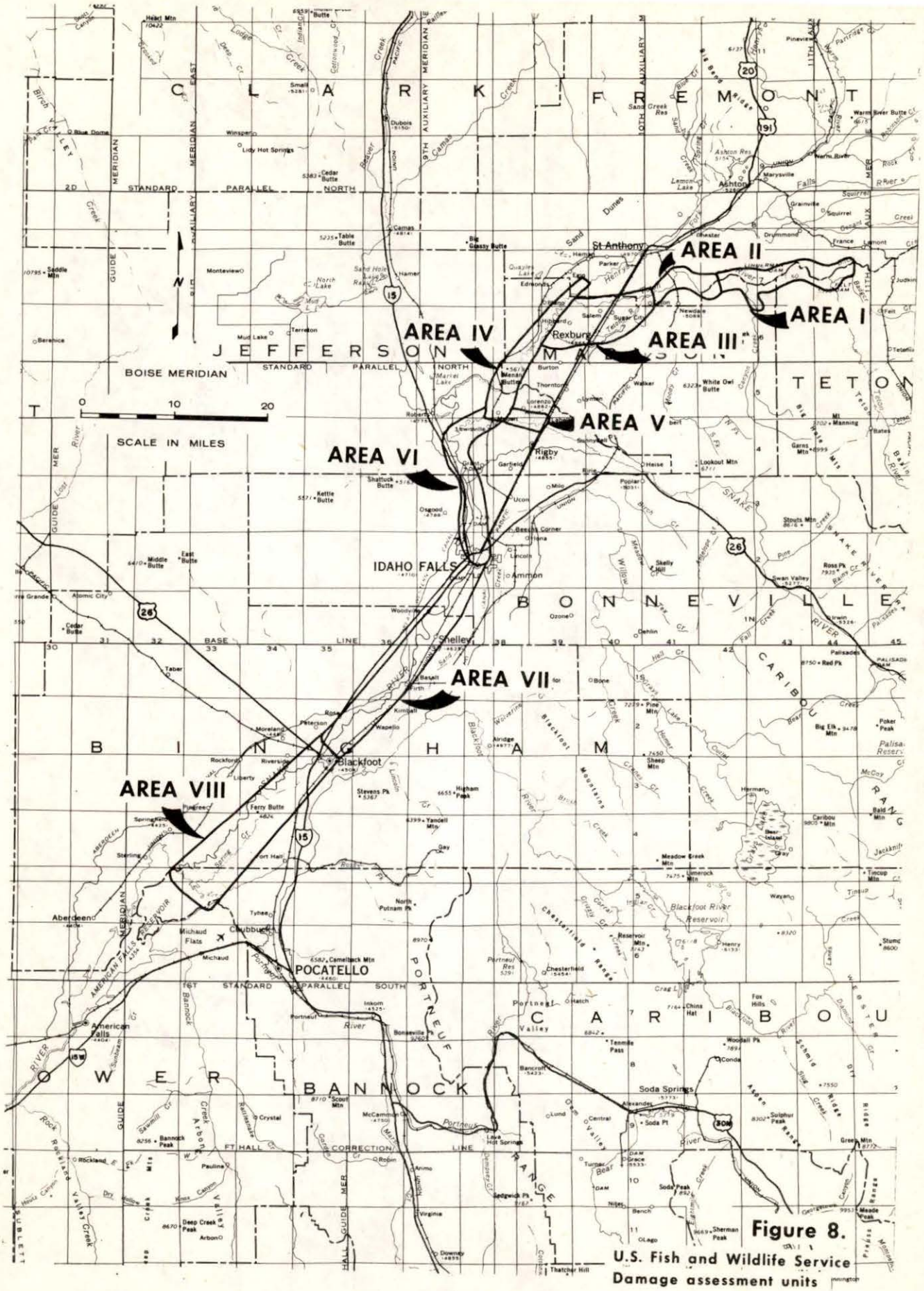


Figure 8.

U.S. Fish and Wildlife Service
Damage assessment units

II. NATURAL RESOURCE LOSSES ATTRIBUTABLE TO THE TETON DAM FAILURE

Fish and wildlife losses resulting from the flood caused by the Teton Dam failure were identified as (1) direct fish and wildlife habitat losses from flood waters, (2) indirect losses of fish and wildlife habitats from flood related restoration and reclamation work, (3) direct losses of animal life in the flood, (4) indirect losses of animal life from flood related causes, such as chemical contamination and poaching, (5) indirect losses through displacement, and (6) long term reductions in wildlife numbers because of changes in land use patterns. Other losses involve fish and wildlife related recreation and the associated economic values.

The river and adjacent lands from the upper end of the reservoir pool to the lower reaches of the flood affected lands were divided into eight units for this report (Figure 8). Those areas are:

AREA I. Reservoir Pool Area: That area extending from the Teton Dam site upstream to the upper reaches of the Lower Teton Diversion Project boundary (Map Appendix, 1).

AREA II. Lower Teton Canyon: That area within the Teton Canyon from the dam site downstream to the diversion of the river into the North and South Forks (Map Appendix, 2).

AREA III. North and South Forks Teton River: To their confluence with the Henry's Fork River (Map Appendix, 3).

AREA IV. Henry's Fork River: St. Anthony, Idaho, to the confluence with the South Fork Snake River (Map Appendix, 4).

AREA V. South Fork Snake River: Lorenzo, Idaho, to the confluence with the Henry's Fork River (Map Appendix, 5).

AREA VI. Main Snake River: Confluence of South Fork Snake and Henry's Fork Rivers to Idaho Falls, Idaho (Map Appendix, 6).

AREA VII. Main Snake River: Idaho Falls, Idaho to Blackfoot, Idaho (Map Appendix, 7).

AREA VIII. Main Snake River: Blackfoot, Idaho to and including American Falls Reservoir (Map Appendix, 8).

A. Fisheries Losses

AREA I. Teton Reservoir area.

Fishery losses directly attributable to the flood were extreme, including the loss of wild and stocked fish, loss of the reservoir, loss of angler facilities, and loss of fisherman use days for an indefinite period of time.

Fish stocked in Teton Reservoir prior to the dam failure (Table 1, Appendix) are a total loss. Most were carried downstream by the floodwaters to be scattered and subsequently stranded over the flood plain. Fish that survived were dispersed throughout the lower Teton and Snake River systems.

Losses of resident fish also occurred. Post-flood surveys indicated that the total game fish population in the river upstream from the dam was similar in density to its pre-impoundment conditions. This condition diminished rapidly because of a lack of habitat, poor food production, heavy siltation and the rapidly increasing population of rough fish. Utah chub and other rough fish were used as bait by reservoir fishermen prior to the dam failure. This, along with improved conditions for rough fish in the Teton and Henry's Fork Rivers due to flood damages, has encouraged their rapid increase.

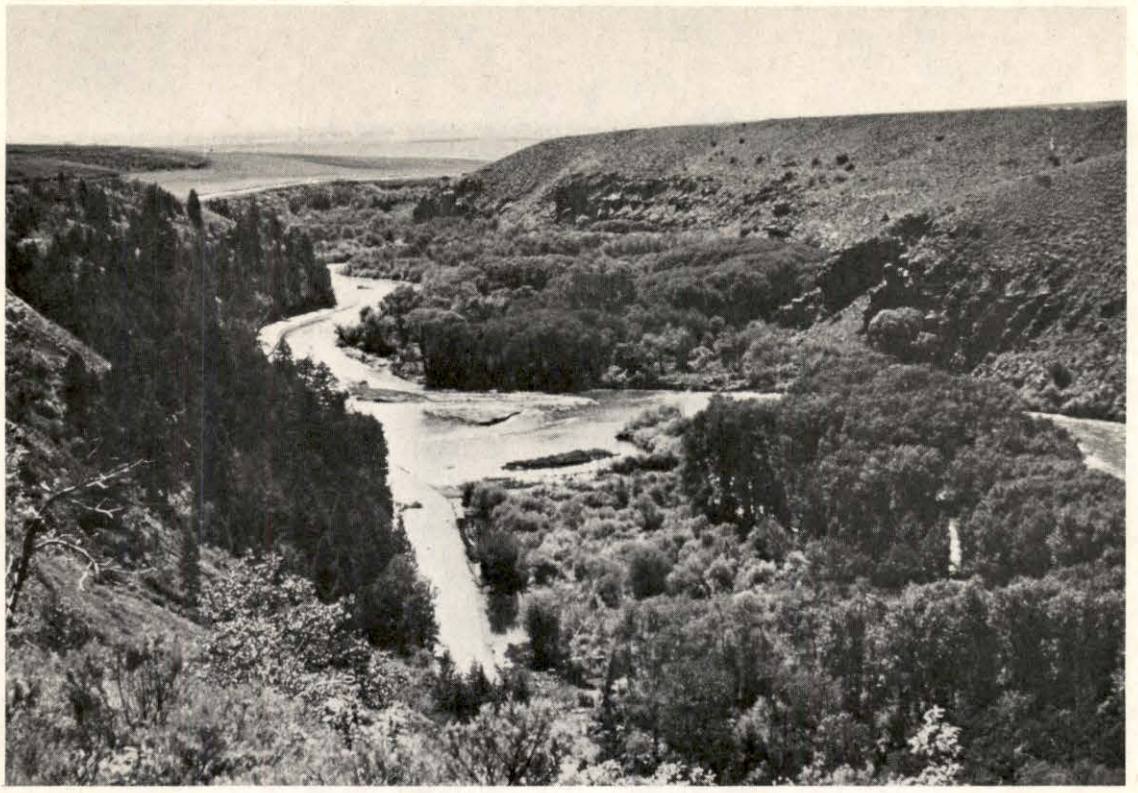
Natural restoration of the stream fishery in the reservoir area will be limited and long term. The reservoir fishery is a complete loss.

AREA II. Teton Canyon below the Dam.

The 12 miles of streambed from the dam site downstream to the North Fork and South Fork Teton Rivers, for the most part, is buried under layers of silt and gravel. Vegetation and soil have been scoured from the canyon walls and deposited on the canyon floor or in the area below the canyon (Figure 9).

Figure 9. Teton Canyon Below Dam - Flood damages.

Figure 10. Teton Canyon Below Dam - Pre-flood



The broad stream bottom and overhanging riparian vegetation, which provided shelter areas for fish, bank stabilization, shading, prevented high increases in water temperature, and added terrestrial insects and organic matter, is now absent (Figure 10). Large unshaded pool areas now exist in which rough fish flourish. In most areas, the stream is not in its former channel and is heavily laden with silt and sand (Figures 11 and 12). The high quality cutthroat trout habitat which existed before the flood is a complete loss (Figure 13).

Figure 11. Teton Canyon Below Dam - Note loss of river channel.

Figure 12. Teton Canyon Below Dam - Note gravel deposits, lack of vegetative cover and channel change.

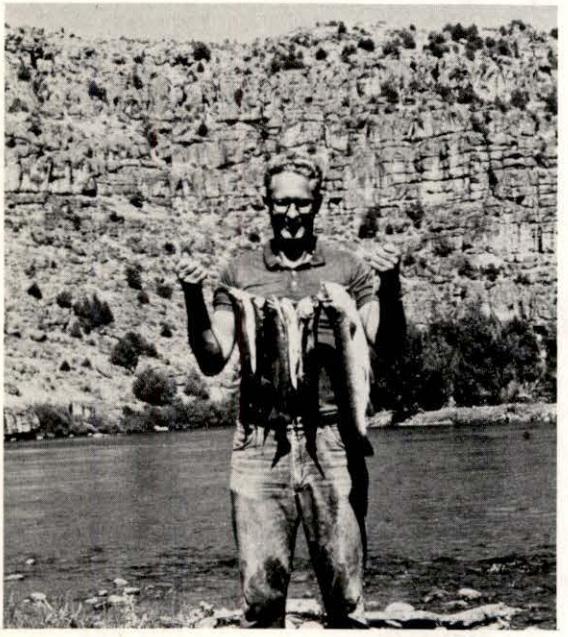


Figure 13. Teton Canyon - Dam site area: Pre-flood catch of cutthroat trout.

Figure 14. Hog Hollow Section of Teton River - Post-flood condition.

Where the river left the canyon at Hog Hollow, the entire stream bottom and adjoining lands were totally devastated (Figure 14).

In the disturbed river channel, heavy equipment activities for reconstruction of bridges and irrigation headworks continue to add to the fish habitat loss. Substrate is the most important factor affecting benthic production. Continued disturbance in this area will hinder benthic recolonization until high runoff has started to stabilize the stream channel. Until the stream is stabilized, benthic organisms have recovered, stream vegetation is reintroduced, riparian vegetation has started, and some degree of canyon bottom shade is established, the fishery will continue to be a complete loss.

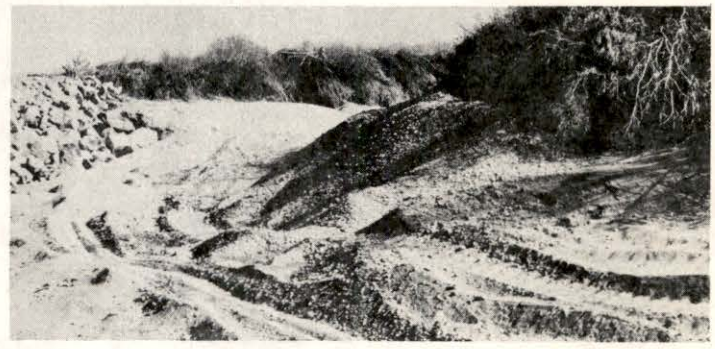
Figure 15. North Fork Teton River - Streambank erosion caused by Teton Dam flood.

AREA III. North and South Forks Teton River.

The fish populations in the North Fork Teton River are a total loss. They were partially destroyed by the Teton Dam failure; then the channel was completely dewatered on September 9, 1976, to facilitate channel restoration and construction of bridges and canal headworks. Consequently, all of the remaining fish were lost. Efforts to salvage the fish were unsuccessful.

As the flood waters left the Teton Canyon near Hog Hollow, they spread to the northwest as well as rushing west through the North and South Forks of the Teton River. As the waters subsided, the overflow re-entered the rivers at 90 degree angles creating extensive bank erosion that sometimes extended for hundreds of feet (Figure 15). The gravel and debris deposits buried much of the original stream bottom. However, the river still retained enough large holes, cutbanks, relatively clean sections of stream channel, and other aspects to provide good fish habitat. After the flood had subsided, restoration efforts were required on the North Fork for flood protection and bridge replacement. To facilitate this program, the North Fork Teton River channel was dry for over four months, during which time heavy equipment was used for channel restoration. The channelization of the river for flood control was devastating to the 17 miles of fish habitat, and all aspects of the fishery in the North Fork Teton River were lost.

North Fork Teton River during post-flood dike reclamation and stream restoration work.



The fish habitat losses in the South Fork Teton River were not as substantial as in the areas upstream or in the North Fork Teton River. Much of the riparian vegetation was left intact. There was deposition and extensive siltation that reduced the fish habitat of the stream in some areas, but the channel was not dewatered during flood restoration work, so complete devastation of the habitat did not take place. Some of the resident fish in this area were displaced by the flood, but only a partial loss can be assumed. Trout have since been observed in the waters of South Fork Teton near Teton, Idaho, and at least one substantial catch was reported.

Rough fish populations have increased because of conditions favorable to them created by flood damage and the flushing of sloughs.

AREA IV: Henry's Fork Snake River from near the city of Elgin, Idaho, downstream to the mouth (including Bannock Jim Creek and Texas Warm Springs)

Dense riparian vegetation along the 24-mile, flood affected section of the Henry's Fork River reduced the flood waters' velocities, resulting in an extremely heavy deposition of debris, silt, sand, and fine gravels in the river channel. Where the flood waters returned to the river, hundreds of acres of riparian lands were eroded away, and the soils were deposited in the river (Figure 16).

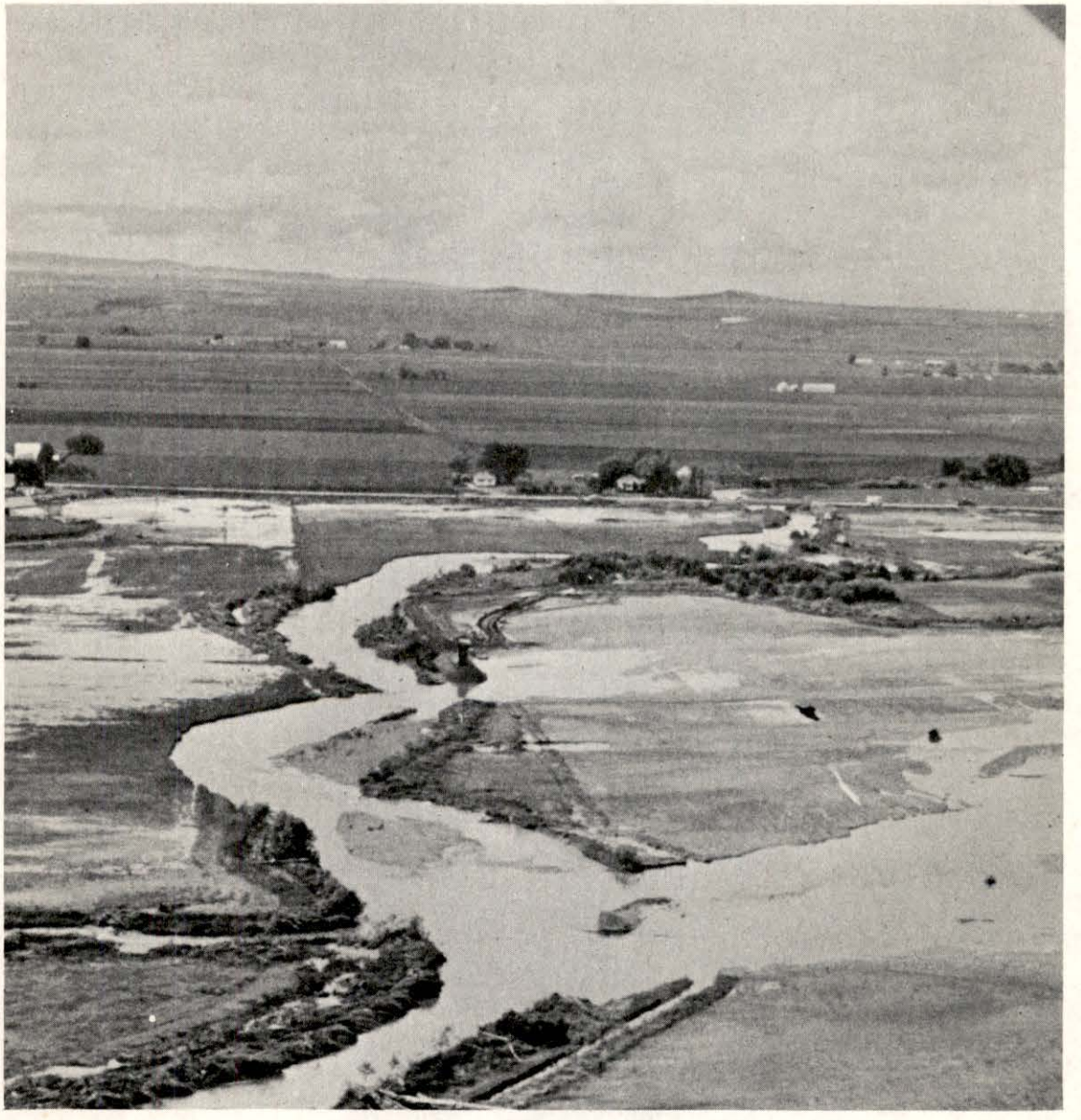


Figure 16. Henry's Fork River - Adjacent farmland erosion and streambank cutting.

Figure 17. Henry's Fork River - Silt and debris deposition caused by Teton Dam flood.

Figure 18. Henry's Fork River - Silt and debris deposition caused by Teton Dam flood.

Some silt deposits existed prior to the flood, but deposition by the flood has severely damaged what fish habitat there was in the Henry's Fork as well as in sloughs and small tributaries in the area (Figures 17-18). Of the 12 thousand-plus acres of flood plain habitat along the Henry's Fork, it is estimated that approximately 300 acres have been totally lost from severe bank cutting and sheet erosion on islands and riparian lands. In addition, an unauthorized but publicly funded fill, installed for flood rehabilitation across the head of the Warm Slough area has dewatered over nine miles of excellent trout rearing habitat. The lower five miles of stream channel in Texas Slough and the lower five miles of Bannock Jim and Spring Slough were also damaged by heavy sedimentation.

Fish that were stocked in areas such as Texas Slough early in 1976 and the resident fish in the Henry's Fork, were exposed to such hazards as being flushed out into farm lands to be stranded. In addition, many perished as a result of having their gills clogged with silt or fine clay and from poisoning. At least half of the resident and stocked fish (Table 1: Appendix) in the flood affected area were lost.

With the degraded conditions which prevailed in the affected reach of the Henry's Fork, rough fish populations in late 1976 exploded, occupying nearly all of the available space. Under its present condition, the Henry's Fork from a point approximately five miles upstream from the confluence with the North Fork Teton (Map, Index 4) is not considered suitable for food production, spawning, or rearing of resident game fish.

AREAS V THROUGH VIII: Main Snake River, confluence of Henry's and South Fork Snake to American Falls Reservoir

Pre-flood data is minimal for this reach of stream so the loss to the fishery can only be estimated. Over the last few years, a good fishery had been developing on the lower sections of Dry Beds, Spring Creek, and other small tributaries to the Snake throughout the flooded areas. In addition, excellent trout fisheries were present in the Fort Hall bottoms and along the Snake River upstream from American Falls Reservoir.

Idaho Department of Fish and Game had expanded fish stocking efforts in these areas and angler use had been on the increase. The fish that had been stocked in these streams as well as resident populations were exposed to the flushing effects of the flood, stranding, poisoning, and suffocation by the fine silts and clays suspended in the flood waters. The loss is considered to be at least one-half of the resident and stocked fish (Table 1: Appendix) that were in these streams. In the reach of the Snake River just above American Falls Reservoir, there was an accidental release of trout from a commercial hatchery. There is no evidence to confirm survival of these fish. Losses which occurred at the upper end of American Falls Reservoir were mostly of rough fish that died from lethal amounts of toxic chemicals. In addition, losses of game and rough fish below American Falls Dam were abnormally high subsequent to the flood. However, no attempt was made to correlate these losses with the possible discharge of contaminated flood waters.

Another loss which occurred involved the inundation of Roberts gravel pit, a 50 acre pond near Roberts, Idaho. Populations of perch and crappie were displaced, and non-game fish were introduced.

Siltation caused by the flood in the lower South Fork of the Snake River, mainstem Snake River, lower Dry Beds, Spring Creek, Big Jimmy Creek, and other areas has caused some damage to the fish habitat. Deterioration of game fish habitat usually favors non-game fish populations. Most non-game species thrive, or at least exist, in habitat that is unusable by trout and other game fish; therefore, there is an inevitable deterioration of the sport fishery. The lower South Fork and main Snake to American Falls supported large numbers of rough fish with some areas of game fish production. The damage to the habitat by the flood has caused an increase in rough fish numbers and subsequently a drop in angler use.

Losses of Fisherman Use (Areas I - VIII)

Loss of angler use in the impoundment area due to the failure of the Teton Dam was nearly 100% for the 1976 fishing season.

Estimated losses of angler days are listed in Table 2, Appendix. These projected estimates are based on Teton River studies conducted in 1974.

Losses in the reservoir pool, from the dam upstream to Bitch Creek, were based on Bureau of Reclamation estimated reservoir recreation use-days for the 100 year life of the project.

All projected stream fishing losses downstream from the dam are based on a natural recovery rate of the stream.

Values of angler days lost are listed in Table 3, Appendix. Total estimated losses for 1976 were $128,800. Losses for the next 100 years without compensation or restoration measures total $43,529,700. These estimates reflect only the economic loss to the area as a result of lost public use and do not include any fish or habitat values.

Figure 19. Teton Canyon above Dam - Slumping above reservoir line.

SUMMARY

Fishery losses include total loss of one reservoir and the stocked fish, irretrievable loss of 12 miles of blue ribbon trout stream fishery and 17 miles of a self-sustaining trout stream fishery, non-recoverable loss of 29 miles of stream without extensive restoration, 50 to 60% loss of 60 miles of self-sustaining fishing streams and sloughs, short term fish losses and limited habitat losses on 100 miles of river, expansion of rough fish populations into 45 miles of previously uninfested streams, and loss of an estimated 12,215,000 man-days of fishing worth 43.5 million dollars.

B. Big Game Losses

Big game losses throughout the flood affected area were mostly from drowning of young of the year. Numerous mule deer and white-tailed deer inhabit the flood plain of the Teton River below the dam and along the Snake River to American Falls Reservoir (Table 4: Appendix). In addition, a small number of resident moose on the Henry's Fork and on the main Snake River near Menan were affected. Intensive searches for big game carcasses were not conducted, but incidental to other work, five dead mule deer were found. Reports of other deaths were received from local residents, persons involved in the emergency flood fight and through local newspaper reports. Total estimated mortalities is reported in Table 5, Appendix.

Sighting of big game animals, incidental to waterfowl counts conducted in past years indicate the big game distribution through the affected area (Table 4: Appendix).

AREA I: Pool area above Teton Dam.

The limited big game winter range on the periphery of the reservoir pool was only slightly affected by slumping (Figure 19). Unless the area stabilizes before a high water year, this loss could increase.

Since this area is a traditional wintering area, there were relatively few animals present. No direct losses were considered to have occurred.

AREA II: Teton Canyon - Dam downstream to North and South Forks Teton River.

From the Teton Dam downstream approximately 12.0 miles, there was a complete loss of all riparian flood plain habitat and portions of the adjacent big sage-bitterbrush and Douglas fir-aspen slope habitats. Nine hundred acres of big game habitat were irretrievably lost.

It is assumed that all of the resident population of adult mule deer and their fawns in the flood plain area of the Teton River, from the dam downstream to the forks of the North and South Forks of the Teton, were lost at the time of the dam failure. Losses were estimated to be 20 mule deer.

AREA III: North and South Forks Teton River to confluence with Henry's Fork River.

Along the North and South Forks of the Teton River, sheet erosion has removed large areas of habitat from production. Much of the habitat affected is expected to recover completely over the next ten years. However, as much as 30 to 40 acres are an irretrievable loss.

From Rexburg to the confluence of Henry's Fork River, the South Fork Teton River maintains a broad willow-cottonwood riparian belt, interspersed with secondary channels, sloughs, marshes, and sinks. Because of its proximity to the city of Rexburg, this area received heavy accumulations of flood debris. Use of helicopters for debris removal greatly reduced the detrimental effect of this activity on the riparian habitats and wetlands. However, many private and Federal debris removal programs often resulted in land clearing. Approximately 40 percent of the total area was reduced to open parks under scattered trees; secondary channels were closed and many sloughs and sinks were drained and filled with debris. Approximately 70 percent of the borders along wetted areas which produced willow, emergent vegetation and cover, was totally destroyed, and in many cases, made non-recoverable by natural means. On other denuded lands, recovery will depend on future land use practices. These affected lands were intermittently used by both deer and moose. With proper land use, the subject lands could have significantly contributed to the overall habitat base.

Adult animal as well as fawn losses occurred in this area. It is estimated that from 5-10 deer using the lower stretch of the South Fork were lost.

AREAS IV, V AND VI: Henry's Fork River, South Fork Snake, and main Snake to Idaho Falls.

Adult animal losses occurred in these areas. Two deer carcasses were found and reports of four others were received from residents of the area by the Idaho Department of Fish and Game and U.S. Fish and Wildlife Service. With adult populations of 100 to 150 deer and 15 to 20 moose, it is conceivable that adult losses were considerably higher than estimated. No indirect losses are considered to have occurred.

Post-flood aerial surveys of the affected areas showed a total displacement of all deer from their original habitat. During the first week, small groups (five to ten head) of white-tailed deer and mule deer were observed grazing on croplands near Menan, Blackfoot and Ferry Butte, Idaho. Approximately 20 head of mule deer were located on Menan Buttes. In each case, all animals were adults. No fawns were present, and none were reported seen by other observers. Aerial and ground searches were made to locate big game animals displaced by the flood, but they were unsuccessful. A total of nine moose (two bulls, six cows and one calf), were counted from Roberts, Idaho, upstream to a point just south of Parker, Idaho. Many of the cows were encountered on several occasions in large open areas. With one exception, none had calves with them.

At the confluence of the North Fork Teton River and Henry's Fork River, the flood waters changed direction by nearly 90 degrees. At this point, large amounts of organic materials (trees, brush, soil) and manufactured articles (mobile homes, autos, metal, buildings, barrels, etc.) were deposited in the riparian bottom lands (Figure 20). Even with this debris mass, direct flood losses to big game habitat along the Henry's Fork Snake River were not as all encompassing as those on the upper Teton, and most affected areas of big game habitat were expected to recover completely over the next five to 15 years. Of the 12 thousand acres-plus of flood plain habitat along the Henry's Fork, it is estimated that approximately 300 acres were totally lost from severe bank cutting and sheet erosion from islands and riparian lands (Figure 21).

Figure 20. Henry's Fork River - Domestic debris accumulation.

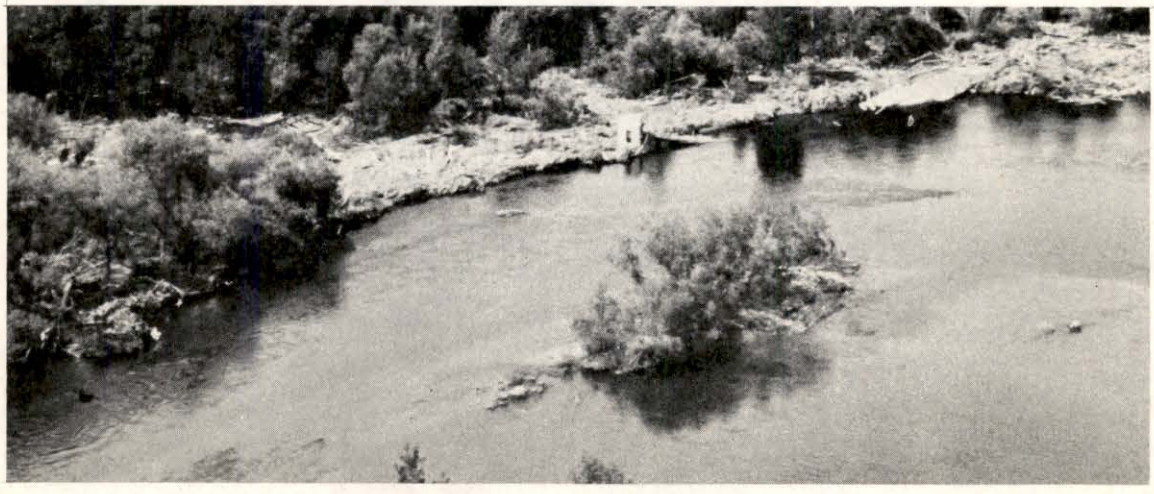


Figure 21. Henry's Fork River - Sand and soil deposits in river channel.

Through SCS, regulated programs and personal efforts by private landowners, debris removal was conducted on most river bottom lands on the Henry's Fork from a point one and one-half miles north of the confluence of the North Fork Teton downstream to the confluence of the South Fork Teton.

Land clearing to remove debris and deposition seriously affected the big game habitat in this area. A total of 3,800 acres of big game habitat was removed from production. Approximately 35 percent of this land has the potential, depending on land use practices, to recover in five to 15 years. The remainder, which consists of filled-in sloughs, secondary river channels and lowlands is non-recoverable by natural means.

Big game habitat losses on the remaining portions of the Snake River to Idaho Falls, Idaho, were minimal. Some bank erosion and heavy silting did occur. Debris deposits were less severe and removal efforts were limited. Approximately 100 acres of pasture and riparian lands were cut off by dikes and are in jeopardy of being modified for agricultural uses. At least 60 acres of these lands were permanently lost.

AREAS VII AND VIII: Main Snake, Idaho Falls through American Falls Reservoir.

Major big game habitat losses occurred during the flood fight and restoration work after the flood. Meanders, sloughs, and wooded inlets were cut off from a permanent water supply by dikes, and vegetated borders were buried under gravel spoil. Approximately 150 acres involved were irretrievably lost.

Loss of big game in the flood was estimated at 40 mule deer. Dead adult animals were observed in this area and numerable reports were received of confused adult animals being driven back into the flood waters by curious on-lookers and people employed in the flood fight. In addition, indirect losses from poaching of displaced animals were reported from areas near Blackfoot and Ferry Butte.

A secondary impact to all of the areas affected was the total displacement of the deer from the flooded areas. As late as December, 1976, there was only minimal evidence of big game animals having returned to their original habitat. This displacement caused a near total loss of hunter-day use for big game in 1976 through the affected area. The loss of hunter use is expected to continue until game populations recover to a huntable number. Total man-days of hunting lost over the next five years are estimated at 2,560 man-days (Table 6: Appendix). The economic value of these hunter days, based on the 1970 National Survey of Fishing and Hunting standard of $17.47 per hunter-day, is $44,723.00

SUMMARY

Big game losses resulting from the flood, flood restoration work, and poaching include 105 to 130 mule deer and white-tailed deer, and four moose, the irretrievable loss of 1,260 acres of big game habitat, the irretrievable loss of 3,380 acres of habitat to restoration measures, and the loss of an estimated 2,560 hunting days over the next five years, valued at $44,723.00.

C. Upland Game Losses

Upland Game animals in the flood affected areas consisted of pheasant, Hungarian partridge, ruffed grouse, mourning dove, and cottontail rabbit. The losses which occurred were from the flooding of nests, drowning of some broods, and the drowning of adult and young of the year rabbits (Table 7: Appendix).

Based on the best information available, upland game losses were estimated to be 22,785 animals (Table 7: Appendix).

Upland habitat inundated by the Teton Dam failure ranged from a fairly low production area below the Teton Canyon to the high production areas of Fort Hall bottoms. The Teton flood plain in and below the Teton Canyon supported a ruffed grouse population of five birds per mile in the timbered and brushy areas along the river.

All of the brush patches, weedy ditches and fence rows in the agricultural areas provided good habitat for cottontail rabbits as well as the densely vegetated areas along the rivers. Numbers of cottontails were estimated at 50 per square mile through the flood affected area.

Pheasant habitat in the flood plain below Teton Canyon consisted of large tracts of irrigated farmland interspersed with brushy ditches and fence rows. Although cover and food did not seem to provide limiting factors, the harsh winters did keep the number of pheasants down in this area. There were an estimated 20 birds per square mile from Teton Dam to the Bingham County line. The Fort Hall bottoms and the area around Blackfoot had a much higher pheasant production than the areas upstream. The productive agricultural activity of the area provided good food and cover for the pheasants.

Winter snowfall and temperatures are not as harsh as in the upper Snake River valley and do not affect the survival of birds as much.

The irrigated farmland through the flood affected area also provided habitat for good numbers of Hungarian partridge. Once again, the harsh winters of the area seem to limit the number of birds more than the available habitat. Although the birds were not as densely populated through the reach as they are in other areas of the state, it is estimated that there were 30 Huns per square mile.

All of the irrigated farmland, brushy vegetation, wooded areas through the flood affected lands provided good habitat for mourning doves. Dove populations were estimated at 40 per square mile.

AREA I: Pool area upstream from the dam: All upland game habitats were destroyed and compensated for with the project.

AREAS II AND III: Teton Dam to confluence of Henry's Fork.

Approximately 1,350 acres of upland game habitat from the Teton Dam site, downstream to the Good Luck Canal diversion near the city of Teton have been irretrievably lost. Below the city of Teton, approximately 36,000 acres of upland game habitat were seriously affected by silting, soil removal, land clearing, land use change, construction of levees, clearing of fence rows and ditch banks, etc. Although the impacts have been extensive, the majority of the habitat areas will recover completely over the next five to ten years, providing some rehabilitation efforts are made. Some long range or permanent losses have and will still occur. Conversely, some areas which were former agricultural lands will now revert to better upland game habitat. Specific locations of prime habitat may change, but the total habitat units in Area I below the city of Teton will not change significantly once the area has recovered.

AREA IV: Henry's Fork River.

As noted under Big Game Habitat Losses, Area IV, approximately 1,300 acres of flood plain habitat have been permanently removed from upland game production. Because of flood related land use changes presently constructed, under construction, or projected for the next year, acreages could approach a 3,000 acre loss by fall, 1977. In addition, approximately 20,250 acres of upland game habitat were seriously affected, but they are expected to recover completely over the next five to ten years, providing minor rehabilitation efforts are made.

AREAS V THROUGH VIII: South Fork Snake River to Henry's Fork, mainstem Snake River to Blackfoot, Idaho.

Permanent upland game habitat losses in these areas are felt to be insignificant. Approximately 6,000 acres were severely affected but are expected to recover completely over the next five to ten years.

Hunter Use Losses

As late as December, 1976, only a few pheasant had been observed in the flood affected areas, and then only along the edges. Some evidence of cottontails was observed on islands near Idaho Falls and Blackfoot.

Other than these few observations, all upland game was either lost or totally displaced from the flood affected areas. The displacement of animals, with the exception of the mourning dove, caused a total loss of man-days upland game hunting in 1976. Because of flood related activities, only an insignificant effort was made to hunt mourning dove, a migratory bird, in the areas affected by the flood in 1976. The loss of hunter use in the affected areas is expected to continue until upland game populations have recovered to their pre-flood levels. Until the losses of nesting habitat, feeding, and roosting areas are recovered or are improved through restoration and compensation, the number of birds available to the hunters will be small. This will directly affect man-days of hunter use. Total man-days of upland game hunting lost over the next 50 years are estimated to be 35,410 (Table 8: Appendix) with an estimated economic value of $344,539.00.

D. Fur Animals

The Teton Dam failure caused extensive losses to the furbearer population downstream from Teton Dam. Many adults and all young of the year were lost. The economic value of the pelts of these animals was estimated by the Idaho Department of Fish and Game to be in excess of $50,000.

On lands that have a potential for recovery from flood damages, the fur animal populations are expected to recover in five to 15 years, depending on the levels of habitat deterioration.

AREA II: Teton Canyon and Dam.

The area from Teton Dam to the forks of the Teton River received the heaviest damage to the furbearer habitat. The riparian vegetation and adjacent fur animal habitat providing food and cover for the furbearers was removed or covered by sediment. The dens were completely silted in or washed away. The 935 acres of furbearer habitat in this area are irretrievably lost.

AREA III: North and South Forks Teton River.

Fur animal habitat on the North and South Forks of the Teton has also been lost.

In addition to the direct habitat losses, considerable indirect losses occurred. Under authority of Section 216 of the Flood Control Act of 1950, the Soil Conservation Service placed approximately 5.1 miles of riprap on stream banks which were formerly available as habitat for fur animals. In addition, private landowners have riprapped some areas with concrete and debris from the flood. One channel around an island in the North Fork of the Teton was closed off and filled in completely. Many sloughs were dammed and/or used as fill areas for disposing of flood debris. The total loss of fur animal habitat in the lower reach of Area III is conservatively estimated at 40 acres.

AREA IV: Henry's Fork River.

The direct loss of approximately 300 acres of fur animal habitat on the Henry's Fork was caused by sheet erosion from islands, stream sides, and agricultural lands. Much of the eroded material was deposited in marsh areas or wetlands. Although streambank habitat was lost, the new banks and riparian vegetation can be expected to recover and be used over the next five to ten years, as animal populations return. Land clearing, permanent changes in land use practices, filling of sloughs, and wetlands, draining of wetlands and marsh areas by dewatering secondary river channels with levees, and placement of riprap has caused the indirect irretrievable loss without restoration measures, of approximately 3,000 acres of fur animal habitat.

AREAS V THROUGH VII:

Although some direct losses did occur in the remainder of the flood affected areas, the fur animal habitat will recover completely over the next five to ten years.

Total fur animal habitat losses are estimated as:

AREA I	Direct, irretrievable	935 acres
	Indirect	40 acres
AREA II	Direct, irretrievable	300 acres
	Indirect	3,000 acres
AREAS III through VI		0 acres
	TOTAL LOSSES	4,275 acres

The production of fur animals on the lands which are considered irretrievably lost had a market value which must be considered a total loss in future years. The value could easily exceed $40.00 per acre per year. At 1977 market values, economic losses would exceed $170,000 annually or over $17,000,000 in the next 100 years.

E. Waterfowl

The failure of the Teton Dam occurred at a time when nearly all of the goose nesting in the upper Snake River valleys had been completed for the year. The goslings were off the nests and congregated in brooding areas, but still flightless. The adult geese in the area had not started to molt and were still able to fly. With few exceptions, the shorebird nesting in the flood affected area had been completed, and for the most part, all young of the year had fledged. Duck nesting activities for the year were about at their peak. Approximately 60 percent of all the ducks were on active nests and/or incubating. Fifteen to 20 percent of the population had broods off. The direct losses which occurred were goslings, flightless shorebirds, shorebird nests, all of the active duck nests, and nearly all of the ducklings which had hatched to that date. It is unlikely that any adult waterfowl or shorebirds were lost as a direct result of the flood.

Data included in the Idaho Department of Fish and Game breeding bird surveys, 1971-1976 (Table 10: Appendix) indicate the average annual waterfowl populations, breeding pairs, nesting density, and success in the flooded area.

Data collected by U.S. Fish and Wildlife Service personnel assigned to the flood are being used for the post-flood comparisons (Table 11: Appendix). Estimates of percent mortality and average goose breeding pair data were used to determine direct waterfowl losses.

AREA II: Teton Canyon, Teton Dam downstream to the North and South Forks Teton River.

The Idaho Department of Fish and Game has not routinely conducted waterfowl surveys on this reach of the river in past years. However, pre-dam construction studies do include some waterfowl figures for the canyon reach from the Teton Dam site to Hog Hollow. Also, breeding pair counts have been taken since 1955.

All of the waterfowl and shorebird nesting habitat from Teton Dam downstream to the division forming the North and South Forks of the Teton River, approximately 13 miles, and all the sloughs, marshes, or wetlands in the reach were totally destroyed. An estimated nesting density of five nests per mile (Idaho Department of Fish and Game standard) through the reach would indicate a loss of 65 nests per year, or the production of approximately 300 ducks annually. Because of greater nesting densities, shorebird production would be approximately 1.5 times this number. This is assuming 75 percent success from the river and 26 miles of riparian habitat. Because the area was totally defoliated, use of this reach by waterfowl for resting and feeding will be minimal or insignificant over the next 100 years. Use of the area by shorebirds will correspond to the foods produced during the progressive recovery of the river. As the river changes from a gravel and sand waste area to a vegetated area, the shorebird species composition will change.

AREA III: North and South Forks Teton River.

The North Fork Teton River from the confluence with the South Fork Teton was dried up for nearly four months, and the river channel and banks were extensively modified. Approximately 30 more acres of potential waterfowl use areas were buried under dike and riprap.

On the North Fork Teton River, because of local agricultural practices, nesting was not as intensive and losses were minimal. The 30 acres of wetlands buried under silt deposits, reduced the nesting habitat in these areas by approximately 50 percent. Some of the riparian vegetation providing shelter and concealment is still present and should recover to a degree over the next few years. Streambank nesting along the 16 miles of the North Fork could be expected to recover to its pre-flood densities over the next two years. Waterfowl use of this area for resting and feeding is not expected to be much below pre-flood levels.

The South Fork Teton from the confluence with the North Fork Teton to Rexburg had limited vegetative cover, but a number of bottomland marshy areas flooded during the high water were excellent waterfowl breeding sites. The re-routing of secondary channels and filling of two major slough areas seriously reduced the limited resource. Approximately 40 acres of habitat were permanently lost.

From Rexburg to the confluence of Henry's Fork River, the South Fork Teton River maintains a broad willow-cottonwood riparian belt, interspersed with secondary channels, sloughs, marshes, and sinks. Because of its proximity to the city of Rexburg, this area received heavy accumulations of flood debris. Use of helicopters for debris removal greatly reduced the detrimental effect of this activity on the riparian habitats and wetlands. However, many private and Federal debris removal programs often resulted in land clearing. Approximately 40 percent of the total area was reduced to open parks under scattered trees; secondary channels were closed and many sloughs and sinks were drained and filled with debris. Approximately 70 percent of the borders along wetted areas which produced willow, emergent vegetation and cover, was totally destroyed, and in many cases, made non-recoverable by natural means. On other denuded lands, recovery will depend on future land use practices. These affected lands were intermittently used by both deer and moose. With proper land use, the subject lands could have significantly contributed to the overall habitat base.

Also, reduced channel capacities in the lower South Fork could cause annual flooding of nests. The full extent of impacts will not be realized until the channel capacity of the South Fork is determined and the flooding monitored. The major impact along the South Fork occurred to the hundreds of acres of marshes, sloughs, and wetlands in the reach which received extensive deposits of silt and debris. Approximately 670 acres of the remaining riparian wetland habitat along the lower South Fork Teton River below Rexburg could seriously be affected by flooding during the nesting season each year. Based on an average of five nests per mile of streambank nesting habitat and the limited renesting due to restoration disturbances, waterfowl losses were estimated to be 300 ducklings.

AREA IV:

The Henry's Fork and Snake River from the confluence of the North Fork Teton River to Roberts, Idaho, sustained the greatest amount of damage to waterfowl nesting habitat of any area surveyed. The major impact was the deposition of thousands of cubic yards of silt, soil, sands, and gravel in prime waterfowl producing wetlands, sloughs, and river channels (Figure 22). Many marsh areas were filled and covered completely by gravels.

Figure 22. Henry's Fork River - sand and soil deposits in river channel.

Figure 23. Henry's Fork River - Domestic debris in channel.

Large amounts of uprooted organic material (trees, brush, soil) and flood-damaged manufactured goods (mobile homes, autos, metal, buildings, barrels, etc.) were also deposited in the riparian bottomlands (Figure 23).

Many secondary channels have been filled in, and large gravel deposits are reducing the main channel capacity throughout this reach of the river. These factors will reduce the carrying capacity of the river causing persistent flooding of waterfowl nesting areas that historically were flooded only during extreme high waters. Based on past flood records, the present habitat available for goose nesting has been reduced by 80 to 90 percent.

Land clearing to remove debris and deposition in wetlands seriously affected the waterfowl nesting habitat in this area. The total potential waterfowl habitat of approximately 3,600 acres was reduced by 60 to 70 percent. If sloughs remain filled, and water is diked away from these bottoms, these lands will all eventually be lost.

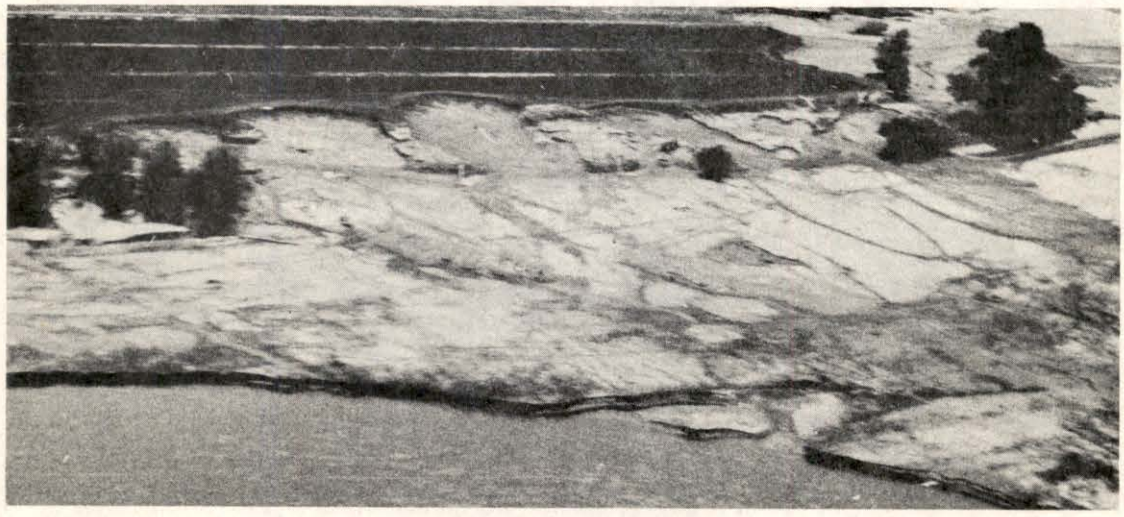
Nesting and re-nesting efforts were prevented by the flood or restoration and debris removal programs. Based on the factor of five nests per mile of waterfowl nesting stream habitat and approximately 60 miles of stream and channels, the waterfowl loss was estimated to be 1,500 ducklings and 200 goslings.

AREA V: South Fork Snake River from Lorenzo to confluence with Henry's Fork.

The extreme lower portion of the South Fork Snake River, where the flood waters of the Teton crossed the main channel, is badly silted from the erosion of streambanks, roads, and adjacent lands (Figure 24). Such erosion will contribute to excessive bed loads until it is stabilized. The loss of channel capacity will also cause persistent flooding at most high water levels and result in a loss of available nesting habitat. Nesting capability on the lower 2.8 miles of the South Fork has been reduced 80 to 90 percent.

Debris accumulation was less severe in this area. Limited removal has lessened the degree of impact to waterfowl habitat. Because of less silting, the effect of debris removal will probably not be significant enough to monitor.

Figure 24. South Fork Snake River - Land erosion creating sediment deposit in river.



AREA VI: Main Snake downstream to Idaho Falls.

Butte Slough and the Deer Park areas are some of the more productive river bottom waterfowl nesting areas in this region.

Debris deposits were limited, and removal efforts were normally not conducted. Approximately 100 acres of either pasture or riparian lands were cut off by dikes and are in jeopardy of being modified for agricultural purposes. Since all are private lands, only those lands affected by dike activities under federal law can be retained. At least 60 acres of these lands will be permanently lost.

All active waterfowl and shorebird nests and all young were assumed destroyed during the flood.

By late July, surveys of the areas indicated that only a minimal or insignificant amount of re-nesting had occurred. Those attempting to re-nest were mostly gadwalls and a few mallards. This situation could have been due to a lack of nesting material or displacement of the populations and re-nesting in other areas. The latter theory is not supported by the amount of nesting activity or populations at waterfowl management areas adjacent to the study area.

Based on previous Idaho Department of Fish and Game production data, waterfowl losses were estimated to be over 2,000 ducklings and 200 goslings. Direct shorebird losses caused by the flood are most difficult to estimate. Most species found in the area nest early and probably suffered limited losses. Willets were nesting in early June; however, a considerable amount of re-nesting effort was observed, shortly after the waters receded. It is assumed that all flightless young of the year, and active nests, of any of the 20-plus different species observed, were lost. Judging from aerial surveys of populations in the area, this loss could have been as many as 1,500 birds.

Roberts Slough is another significant waterfowl, shorebird, and marsh bird nesting site. Although all first nests were destroyed by the flood, a significant amount of re-nesting was apparent. Black tern and western grebe colonies were re-established, and many waterfowl broods were counted. Only two nests of glossy white-faced ibis were located, however. Early reports by U.S. Fish and Wildlife Service biologists showed approximately 20 nests in this area. Since the glossy white-faced ibis is a species of concern and is considered for threatened or endangered status, this nesting loss is significant.

Goose nesting on the mainstem Snake River from Roberts Slough downstream to Blackfoot is generally insignificant. In 1976, approximately five pair were observed in the area prior to the flood. No geese were observed during the post-flood surveys.

Direct damages were limited and short term. All lands not affected by post-flood activities will recover in three to five years. Channel changes, riprapping, and gravel removal damages were more significant than flood damages. Of the nearly 200 acres affected, all but 60 will recover in five to 15 years.

Debris deposits were spotty through this area. Because of location and land use practices, little debris removal was conducted, and the major losses occurred on some private and State highway lands.

This area includes the Fort Hall bottoms and Big Spring Meadows, which are outstanding waterfowl nesting areas. Direct losses through nest destruction was high. Re-nesting was significant in those areas not heavily silted. However, 150 goslings and 3,800 nested eggs and ducklings were still lost.

Shorebird, marsh bird, and wading bird surveys have not been conducted as systematically as have Canada goose surveys. Therefore, estimates of the amount of nest destruction and brood loss were made on the basis of nest densities, population counts, brood counts, re-nesting efforts, and success. This area supported great-blue-heron, common egret, and black-crowned-night heron rookeries as well as large nesting populations of shorebirds. Although numerous adults were counted, no juvenile birds were seen through late August, and losses were estimated to be in excess of 2,000 young.

Indirect Losses: Areas III - VIII

Indirect losses of waterfowl, shorebirds, and marsh birds in Areas III through VIII were a major concern because of the types and amounts of agricultural chemicals lost in the flood. However, because of the inability to mount an intensive chemical evaluation survey early in the post-flood studies, chemical problems or the exact numbers of birds affected by chemicals are indefinite.

Surveys, collections, and chemical analyses did confirm the deaths of 57 white pelicans and a small number of western grebes. Other dead birds reported were great-blue heron, snowy egret, and ring-billed gulls, but no analysis was run to determine their cause of death.

Long term habitat contamination could be caused by a number of chemicals known to have been lost and not recovered. One of these, Furdan, is highly toxic to waterfowl. Also, there is the possibility of PCB's in soils where powerline transformers were located. A pesticide monitoring program conducted during September and early October did not reveal any areas of high chemical levels. However, there still remains the possibility of isolated problem areas where

unlocated chemical barrels might break during period of high water. Because of the unpredictability of these potential accidents, the level of habitat contamination cannot be determined.

Hunter-Days Lost:

Approximately 10,000 duck and 1,400 goose hunter-days of activity (Table 12: Appendix) occur annually in the five counties affected by the flood.

The value of lost waterfowl hunting over the next 50 years will be approximately $6,300,000 (Table 13: Appendix). Significant losses in cover and food will affect the ability of the area to support pre-flood levels of waterfowl for many years. Loss of hunting activity will not be caused by lack of hunter demand, but by habitat limitations or the waterfowl supply.

SUMMARY

Waterfowl and shorebird losses either directly or indirectly related to the flood include loss of 770 goslings, 8,300 nested eggs and ducklings, and approximately 5,000 shorebirds, destruction of approximately 2,100 acres of waterfowl habitat by flood action (does not include area used by both waterfowl and big game and recorded under big game losses), loss of approximately 3,000 acres of habitat to debris clearing, and loss of 10,000 duck and 1,400 goose-hunter-days with an economic value of approximately 6.3 million dollars.

F. Non-Game (Birds and Small Mammals)

Very little information is known about the non-game species, such as passerine birds, raptors and small mammals. Limited census data from Christmas counts, breeding bird surveys, local birdwatchers' field notes, and bird lists indicate approximately six species of raptors, and 28 species of passerine birds nest in the Snake River bottoms. All low brush, ground, bank and bridge nesting birds' nests and young were destroyed. Swallow nests alone, based on average nests per highway bridge data and the number of bridges lost, are estimated to exceed 20,000 nests or nearly 65,000 young. Three known bank swallow colonies of over 5,000 nests, were totally destroyed. Mud and gravel deposits buried the dense low grass on many islands, destroying nesting cover of many ground nesters for one to 15 years, depending on the area. Based on known nesting density studies of brush and ground nesting species in comparable habitats, total nest losses were estimated at 100,000 to 150,000 with an average of 3.5 young per nest.

Because of riprapping, stream channelization, vegetation removal, and future land use practice changes, much of the low brush, dense grass habitat will not recover.

Economic costs of non-game bird losses are hard to assess. However, increasing interest and activities associated with non-game species indicates they have significant value.

STUDIES NEEDED AND MITIGATION, REHABILITATION, AND COMPENSATION MEASURES REQUIRED FOR THE FISH AND WILDLIFE RESOURCES ADVERSELY AFFECTED BY THE FAILURE OF THE TETON DAM PROJECT, IDAHO, ON JUNE 5, 1976

The objective of the measures recommended in this section is to restore self-sustaining fish and wildlife populations to their pre-flood status in the areas affected by the Teton flood of June 1976. In some instances, this objective will be unattainable and compensation will be needed.

Two separate situations are taken into account in making these recommendations. One is with the Teton Dam authorized for reconstruction, and the second is without reconstruction of the dam. Many of the measures recommended will apply in either case and are so identified.

Fish

Restoration, Mitigation and Compensation

Destruction of the fishery of the Teton River, Henry's Fork, and the Snake River resulting from the failure of the Teton Dam is unprecedented in recent history. Debris from the dam site deposited in the stream channels and the emergency flood rehabilitation efforts that followed the flood have eliminated the quality habitat and the cutthroat trout fishery. Rehabilitation of the fishery will require extensive use of stream improvement measures, chemical control of undesirable species, and a long term restocking program. Restoration of a self-sustaining fishery may require between eight to 20 years depending on the intensity of the rehabilitation program.

A. Fisheries Studies

Because of the magnitude of the problem and uncertainties involved in rehabilitating a river, it is proposed that a Teton River Fishery Task Force be formed to provide overall direction and coordination for rehabilitating the river and restoring the fishery. The Task Force would be composed of the following individuals or their designees:

Area Manager, U.S. Fish and Wildlife Service
State Conservationist, U.S. Soil Conservation Service
Director, Idaho Department of Fish and Game
Director, Idaho Department of Water Resources
Project Manager, Bureau of Reclamation

This group would be responsible for monitoring the river, for developing rehabilitation methods and strategies, for evaluating the effectiveness of various methods, and for designing and implementing an overall plan for rehabilitation of the river and fishery. The Task Force would meet monthly or bimonthly during the initial phase of the rehabilitation efforts. As surveys and studies were completed and definite plans were formulated, the meetings would be spread out to quarter or semi-annual intervals, as appropriate.

Technical and clerical support for the Task Force would be provided by the National Stream Alteration Team (NSAT), Office of Biological Services, U.S. Fish and Wildlife Service and would be funded through the Bureau of Reclamation. A biologist, physical scientist, and clerk-typist would be stationed in Idaho to provide direct support to the Task Force. They would be responsible for gathering all the relevant information on the river and rehabilitation methodologies and assembling and synthesizing this information for the Task Force. In addition, the NSAT group would coordinate and manage all surveys and research efforts related to the stream rehabilitation of the Teton, Henry's Fork and Snake Rivers. All field survey and research would be contracted.

The objectives of the Teton River Fishery Task Force and the NSAT group will be:

1. To monitor changes in stream morphometry, water quality and quantity, and the fishery of the Teton River, Henry's Fork and the Snake River.

2. To evaluate the effectiveness of various stream improvement methods and other alternatives for restoring the fishery of the rivers.

3. To determine the total recovery period of the rivers and fisheries.

4. To formulate and implement a plan for restoration.

5. To administer contracts for fisheries, revegetation, and stream restoration studies.

Surveys or studies to be coordinated and managed by the NSAT group include:

1. A survey to monitor and assess water quantity, selected water quality parameters, suspended-sediment and bed load discharge, and stream morphometry in selected reaches of the Teton River, Henry's Fork and the Snake River. The surveys will be conducted annually for a period of ten years or until a sustained fishery is assured.

2. A survey to monitor and assess the fishery of the Teton River, Henry's Fork and the Snake River. The survey will be conducted concurrently with the survey of physical characteristics of the rivers. This survey will provide the base for the Teton River Fishery Task Force to assess the response of the fishery to natural and man-made changes in the river and to make decisions on the use of various alternatives, such as dredging, chemical treatment, stream improvement structures, and restocking levels.

3. A bed load model study of the Henry's Fork and the Snake River to determine the time required for natural flushing and/or mechanical removal of sediment deposits resulting from the Teton flood. This will facilitate decisions on whether to dredge or allow natural scour and cleansing of the river to occur.

4. Special studies to evaluate the effectiveness of various stream improvement methods. There will be discretionary studies of the Task Force and the NSAT group to design and evaluate new and innovative methods and structures for improving stream habitat.

Rehabilitation Study Costs

Travel expenses of Teton River Fishery Task Force	
$ 5,000/year X 10 years	$ 50,000
NSAT group - Salaries and Expenses	
$100,000/year X 10 years	1,000,000
Subtotal	$1,050,000
Annual survey of physical characteristics of rivers	
$200,000 first year	$ 200,000
$100,000 each additional year	$ 900,000
Annual survey of fishery	
$ 60,000/year	$ 600,000

Bed load model study (3 years)	$ 300,000
Stream improvement pilot studies (5 years)	500,000
Subtotal	$2,500,000
TOTAL	$3,350,000

B. Mitigation Measures, Rehabilitation and Compensation

To restore the self-sustaining fisheries to pre-flood (June 1976) status and to insure that the benthos and other aquatic organisms are able to recolonize and sustain production to the pre-flood level, the following measures would be required. These proposals are first estimates of needs and costs of the fisheries rehabilitation requirements. They will be used as initial guidelines by the Teton River Fishery Task Force for developing and implementing a complete rehabilitation plan.

AREA I: Reservoir Pool Area.

A. With the reconstruction of the Teton Dam.

In the event that the decision is made to reconstruct the Teton Dam, all of the mitigation measures identified for the reservoir prior to the collapse of the dam would still be applicable (Appendix A). In addition, the river and pool area would have to be chemically treated to eradicate rough fish now present in the stream from Felt Dam downstream to the Teton Dam.

Downstream siltation caused from erosion of the slumps in the former pool area would continue unless an adequate soil stabilization program were initiated. The on-going revegetation of the pool area is expected to slow the erosion and sloughing in problem areas, but this should be monitored, and if sloughing continues, mechanical measures should be instigated.

During the next year and through the period of construction, a minimum of five large gabion dams would have to be placed in the bottom of Canyon Creek to stabilize the sediments which are now washing down into the lower Teton River.

Estimated costs for additional fishery measures in the Teton Pool Area because of the dam's failure which are not identified in the original loss mitigation package (Appendix A) are:

MEASURE	INITIAL COST	ANNUAL O&M
Chemical eradication of rough fish	8,000	-0-
Soil stabilization	-0-	10,000[1/]
Gabions in Canyon Creek	12,500	
	$20,500	$10,000

B. Without the reconstruction of the Teton Dam.

In the event the Teton Dam were not authorized for reconstruction, the stream should be restored in such a way that it would be able to sustain the same quality habitat and cutthroat fishery it had prior to the construction of the dam. The Teton River through the canyon area was a high gradient stream with good natural production that maintained a large population of native cutthroat trout. The river channel was composed of long, gravel-bottom riffles with scattered large boulders.

The first consideration in restoring the river through the Teton Canyon would be the controlling the sloughing of the canyon walls. The Bureau of Reclamation has a project underway to revegetate the pool area of the canyon. It is expected at this time that the revegetation of the canyon walls would stabilize the sloughing and reduce surface erosion. Before any fishery restoration were undertaken, a monitoring program should be set up to look at all areas of the canyon where sloughing is taking place. Someone with expertise in the area of soil displacement should be contracted for this program (Appendix B). If the revegetation project would not stabilize the sloughing, mechanical measures should be employed; the extent and cost evaluations should be developed at that time by the Bureau of Reclamation and the consulting contractor. Some areas of the canyon have deep deposits of silt and the water is eroding through these deposits, cutting a deep unstable channel. These areas must be stabilized or removed before any fishery rehabilitation can take place.

[1/] To be continued until dam completion.

All major pool areas (approximately 19) which were created by the massive slides that have dammed the river, would have to be mechanically excavated and drained. Slides should be removed from the river as much as is practical, and in such a manner as to restore navigation by float craft to pre-impoundment conditions. Costs of removal of the slides are based on the ability to remove all structures with D-9 or equivalent tracked bulldozers. If drilling and blasting were required, the costs would be appreciably higher.

Estimated total yds - 19 slides - 680,000 @ $4.00/yd =

$2,720,000

After the erosion were controlled and the slides had been removed from the channel, the next step in restoring the fishery would be to let the natural mending process begin. Within the confines of the canyon, the river should be allowed to form its own channel. This process is already in progress but would not reach full force until high waters removed some of the surface silts and fines and cut out some of the very small pool areas dammed by the sloughing canyon walls.

When the channel has stabilized after spring runoff, a study program will have to be set up to assess the condition of the fish habitat through the canyon reach, in comparison with the composition and gradient of the stream channel prior to construction of the dam and the dam failure (Table 14: Appendix).

It may be determined from this study that the natural mending process of the stream cannot restore the fish habitat to an acceptable level, in which case, extensive habitat rehabilitation may be required. If this determination is made, all work to rehabilitate the habitat should be done under the direction of the Task Force.

In order to achieve pre-construction levels of aquatic production, riffles should compose two-thirds of the stream length. Bottom structure should provide cover for the fish and for colonization of the benthic organisms. This may require shaping of the river channel or placement of artificial structures as listed in Appendix C. Other work, such as dredging, riprapping, excavation, and further revegetation may be needed to restore the integrity of the stream channel. Where mechanical restoration of the channel is required, large stones or boulders found

in the debris should be replaced in the channel to provide resting and hiding shelters for fish. Large boulders or gabions placed near the outer side of a curve or bend in the stream would also absorb some of the energy of heavy runoffs and help to deflect the current from the streambank. Again, caution should be taken not to obstruct navigation by float craft.

Canyon Creek presents a somewhat different problem. The possibilities of re-establishing a fishable trout population in Canyon Creek would be negligible.

Nearly 100 percent of all the soils on the canyon walls sloughed into the canyon bottom. The disturbed and unsorted materials are now eroding at a rapid rate and entering the Teton River below. An extensive effort would have to be made to stabilize these materials and prevent them from degrading other habitat areas. The placement of gabions, rock weirs, groins, etc., in the channel would help trap the sediments. The exact number of units would have to be determined by hydrological engineers and should be coordinated through the task force.

Estimated number of structures and costs are:

Physical structures:	10 @ $2,500	= $25,000
O&M: 10 years	@ $5,000	= 50,000

After completion of the rehabilitation work, a fisheries study program would be needed to determine the species composition and relative abundance of the fish populations in the Teton River. This should be coordinated through the Task Force and NSAT. The study should provide data to determine the probable rate of natural recovery, to develop an annual stocking program, and to monitor the fish population until it reaches preconstruction levels.

If non-game fish were found in excessive numbers after restoration of the fish habitat were complete, chemical treatment to eradicate undesirable species should be undertaken.

The estimated costs of the study and restocking program are:

5 year study	$125,000
10 year recovery monitoring (initiated at end of 5 year study)	50,000
8 year trout stocking program	96,000
Chemical treatment	8,000
TOTAL	$279,000

The fishery rehabilitation measures which have been identified above for the former Teton pool area, in conjunction with the revegetation program initiated in the fall of 1976, would rehabilitate the Teton Canyon to the extent practicable.

AREA II: The Teton River below the Teton Dam.

The reach of stream from Teton Dam to the forks of the Teton supported a good trout population before the failure of the Teton Dam. The bottom type through this reach of the river was a highly productive gravel type that supported a blue ribbon fishery. The need for restoration of this reach of stream will be the same without or with the reconstruction of Teton Dam.

In his initial comments concerning the rehabilitation of the flood affected areas, then Governor Cecil Andrus, Idaho, stated that the river would have to be restored to its original stream channel. In Area II, this would require removal of all gravels in the Teton River channel below the dam, the re-establishment of the river in its former channel and revegetation of the canyon flood.

Based on Bureau of Reclamation work below the dam, the length and width of the canyon flood and the types of materials deposited, the estimated costs of removing the gravel and reshaping the stream are:

Gravel removal - 11.5 miles of canyon floor: Approximately 45,500,000 cu. yds. @ $2.00/yd =	$91,000,000
Stream reconstruction	1,000,000
TOTAL	$92,000,000

Once this was completed, a complete revegetation plan would have to be initiated, the stream treated for trash fish and a long range restocking program would have to be started. Estimated costs of these programs are:

Revegetation	$	200,000
Chemical treating		6,000
8 year stocking @ $12,000/yr		96,000
TOTAL		302,000

A second alternative which the U.S. Fish and Wildlife Service recommends, calls for the establishment of a multi-interest study team to function for a period of two years to develop a rehabilitation and management plan for the area. Stream rehabilitation work would be a portion of this effort but would be pursued only to the extent practical. Initially, high water from spring runoff would be allowed to reshape the river channel and scour as much silt and sand as possible. Not until after the stream had determined its own channel direction would the work to restore the fishery habitat begin.

Gravel, silt, and sand deposits which must be removed from various sites would be removed with as little disturbance to the downstream habitat as possible. Some areas might require riprapping, channeling, leveling, or other measures to restore some semblance of the original stream channel.

During construction, consideration would be given to the original gradient and bottom type listed in Table 14 (Appendix). After construction, an assessment by the fishery study contractor would be made of the condition of the fish habitat. If further work or placement of artificial structures (Appendix C) were needed, this work would be done under the supervision of the Task Force.

The entire 11.5 mile reach below the dam would be revegetated with trees and brush species similar to those listed above for the pool area. Approximately 80 acres of streambank would be cleared of heavy gravels to accommodate these plantings. Clearing would be only 20 to 25 feet back from the accepted stream banks.

When the fish habitat was adequate to support a good fishery, the reach would be chemically treated to eradicate undesirable species and then would be restocked annually for eight years with trout.

An evaluation of the fishery would be needed at the end of the eight year period after construction. The study would be conducted by the fishery study contractor to determine if natural reproduction were occurring at adequate levels and the fish species composition, size, and approximate densities. An evaluation would then be made as to whether or not additional stream improvements are needed.

Estimated costs of Alternative 2 are:

	INITIAL COST	ANNUAL OM&R
Studies	$ 100,000	
Construction and artificial stream structures	2,300,000	$ 2,000
Revegetation	100,000 1/	2,000 2/
Chemical treatment	6,000	
Stocking (8 years)	12,000	12,000 3/
TOTAL	$2,518,000	$16,000

1/ Estimate based on cost of 1976 reservoir area revegetation plan.

2/ Ten year recovery period.

3/ To continue for seven years after the initial stocking. At the end of eight years, it is hoped that a self-sustaining population of trout would have been established.

These measures would restore approximately 25 to 40% of the pre-flood fishery over the next 100 years.

AREA III:

Within the North Fork of the Teton River, studies are underway to monitor stream channel morphometry and benthic organism recolonization. When it has been determined that the channel has stabilized and the benthic and other aquatic organisms have started to recolonize, the fisheries study contractor should analyze the fish habitat situation for the river. At present, much of the channel has been disturbed and the holes, cutbanks, and riparian vegetation have been removed.

Pool-riffle ratios and availability of fish cover should be looked at closely. Good spawning gravels would be placed through the North Fork. If fish cover is not adequate, structures would have to be placed in the stream channel (Appendix C). All construction would be done under the supervision of the Task Force.

The reach would be chemically treated to eradicate undesirable species and would be planted with trout. A monitoring program would be established to determine when a self-sustaining fishery had been re-established and the restocking program could be discontinued.

The needed rehabilitation of the fishery through the reach would be the same with or without the reconstruction of the dam.

The removal of silt and the availability of fish cover are principal factors in rehabilitating the fish habitat in the South Fork Teton River. The fishery study contractor should address the morphology of the stream channel to determine if adequate fish cover is available. If not, dredging, excavation, and construction of stream improvement structures would be needed to restore the integrity of the stream channel. All construction would be done under the supervision of the Task Force.

Non-game fish populations would be estimated, and if undesirable fish populations are excessive, they would be eradicated and the stream restocked with trout.

The needed restoration of the fishery in the South Fork Teton would be the same with or without the reconstruction of the dam.

Studies and Projects related to the restoration of the fishery in the Teton River presently underway are:

A. U.S. Geological Survey is under contract to the Soil Conservation Service to monitor bed load, substratum analysis, and stream channel morphometry in North Fork Teton River.

B. Dr. Wayne G. Minshall, Idaho State University, is under contract to the Soil Conservation Service and Bureau of Reclamation to take core samples from the North Fork Teton River channel to determine organic content and monitor benthic organism recolonization when water is returned to the North Fork Teton River.

C. Revegetation of the levees and streambanks on the lower Teton River is a Soil Conservation Service project that is proposed.

D. Extensive revegetation efforts of the pool area above Teton Dam are a Bureau of Reclamation project.

AREA IV: Henry's Fork Snake River, Warm Slough, Texas Slough, and Bannock Jim Creek.

Initially, studies must be conducted on the Henry's Fork Snake River to determine the approximate volume of fines deposited in all of the major channels of the affected area. Our initial estimates indicate that this could exceed five million cubic yards of material. Included in the study would be particle size, bed load movement, and estimated time for the river to cleanse itself or reach equilibrium based on the water records of the past 20 years. The bed load information is necessary to determine the extent of the impacts on the Henry's Fork areas and the impact this will have on the downstream habitat over the next 100 years.

Two alternatives for fisheries restoration have been considered. The first involves restoring the damaged portion of Henry's Fork to its pre-flood condition. This would require silt, sand, and gravel removal on approximately 66 miles of major stream channels and numerable miles of secondary channels. All spoil materials would have to be pumped to areas which were severely eroded by the flood or hauled to local gravel quarries which are not in use. The estimated cost of such an operation is between 7.5 and 11.5 million dollars, depending upon suitable sites for pump disposal and haul distances.

A second alternative would be to consider the habitat and its fishery a non-retrievable loss over the period of time identified in the bed load studies for the river to reach equilibrium.

Compensation would be necessary to offset these losses. The exact time and estimated value of the losses would have to be determined by the Task Force and the fishery study contractor. Once these were established, necessary compensation and restoration measures, other than fish replacement, could be identified.

The flood affected areas of Texas and Warm Sloughs and Bannock Jim Creek should be chemically treated for eradication of undesirable species and then restocked with trout. This would require the temporary placement of migration barriers.

Some of the lands surrounding sloughs and secondary channels in this area are being recommended as acquisition compensation for waterfowl, upland game, furbearers, and non-game species. If these lands become public property, restoration measures can be conducted on channels that traditionally supported game fish. Estimated cost to restore 60 miles of channels is:

Gravel removal (mainstem)	$1,000,000
Gravel removal (secondary channels only)	160,000
Chemical treatment	3,000
Trout restocking - eight years @ $10,000	80,000
TOTAL	$1,243,000

All rehabilitation and compensation would be the same with or without dam reconstruction.

AREA V THROUGH VIII: South Fork Snake River to American Falls Reservoir, Spring Creek Dry Beds, and other small tributaries.

Through the flood affected areas of Spring Creek, the Dry Beds, and other small tributaries, all major silt deposits need to be removed. The reaches of stream should be chemically treated to eradicate undesirable species and then restocked with trout. Silt and sand deposits in the South Fork and main Snake River to American Falls should be allowed to transport and be cleansed by the natural hydraulic actions of the river. Bed load movements through the areas need to be monitored. A fishery study is needed in these reaches to determine species composition, possible areas for habitat improvement measures and to develop a stocking program to meet public demands. It is doubtful that limnological studies of the mainstem Snake River or its tributaries would provide enough significant data to be of practical use in the rehabilitation of the fishery.

Estimated costs for restoration measures in Areas V through VIII are:

Silt removal and artificial habitat improvements	$ 150,000
Fishery studies	50,000
Sediment studies	50,000
Chemical treatment	8,000
Stocking trout - eight years	100,000
TOTAL	$ 358,000

All rehabilitation and compensation would be the same with or without dam reconstruction.

A fish hatchery is needed in order to provide the levels of fish production necessary to replace that which is considered an irretrievable loss in the lower Teton River (Area II), the Henry's Fork Snake River (Area VI) and in the mainstem Snake (Areas VI through VIII). Additional fish hatchery facilities having the capacity to produce 500,000 catchable trout per year would be needed. The fish produced at such a facility would be used to stock streams, ponds, and rivers in and in the general vicinity of the flood affected area. A total of six to eight raceways depending upon design would be needed. Four rearing ponds would be required in the same general vicinity, as well as the permanent support structures, such as homes, equipment sheds, and trucks. The facility should be operated by the Idaho Department of Fish and Game with funding provided by the Federal government based on the actual costs of production, operation, maintenance, and replacement over the next 100 years.

The estimated costs of hatchery construction and O&M are:

	INITIAL COSTS	ANNUAL OM&R
Fish hatchery and rearing ponds	$2,000,000	
O&M	-0-	$100,000
TOTAL	$2,000,000	$100,000

SUMMARY

Estimated costs of rehabilitation of the fishery after Teton Dam failure are:

I.	Stabilization of soils in Teton Canyon	
	A. Contract for monitoring soil movement	$ 20,000
	B. Further stabilization of soil ($50,000 up to)	100,000
II.	Studies	
	A. Task Force and directly related studies	$3,350,000
	B. Fishery rehabilitation studies	175,000
	C. Fishery recovery monitoring	50,000
	D. Phase I and Phase II	75,000

E.	Stream rehabilitation studies independent of Task Force	$ 150,000
III.	Construction of rehabilitation measures.	
A.	Teton Canyon	
1.	Slide removal and grading stream channels in these areas	2,720,000
2.	Large boulders relocated in channel in canyon to help restore the integrity of the stream	30,000
B.	Canyon Creek	
1.	Gabions placed in channel in Canyon Creek to stabilize banks 8 @ $2,500 ea	20,000
2.	Gabion weirs placed in lower end of channel to catch silt moving out of Canyon Creek but built low enough to provide for passage 2 @ $2,500 ea	5,000
3.	Maintenance and annual supplemental costs 10 years @ $5,000/yr	50,000
C.	Teton Dam to forks	
1.	Excavate stream channel; riprap and levee where needed - grade stream	2,300,000
2.	Revegetation costs	120,000
D.	North Fork Teton	
1.	Additional stream improvement structures if needed	300,000
2.	Silt removal	100,000
E.	South Fork Teton	
1.	Additional stream improvement structures if needed	100,000
2.	Silt removal	100,000

F.	Henry's Fork (Texas, Warm, Bannock Jim Sloughs)	
1.	Silt removal (main river channel)	$1,000,000
2.	Silt removal (sloughs)	160,000
G.	South Fork and main Snake (Spring Creek, Dry Bed)	
1.	Silt removal	150,000
IV.	Chemical eradication of undesirable fish after habitat restoration.	
A.	Teton Canyon	6,500
1.	Canyon Creek	1,500
B.	Teton Dam to forks	6,000
C.	North Fork Teton	1,040
D.	South Fork Teton	1,560
E.	Henry's Fork	
1.	Bannock Jim Slough	1,200
2.	Texas Slough	1,200
3.	Warm Slough	1,200
F.	Snake River and South Fork	
1.	Spring Creek	1,200
2.	Dry Bed	1,800
V.	Fish stocking after rehabilitation	
A.	Teton Canyon	

1. Without dam reconstruction 500,000 young-of-the-year cutthroat for eight years (helicopter plants)

500,000 @ $7,500/yr for 8 years	=	$60,000
8 helicopter flights	=	36,000
Subtotal		$96,000

96,000

2. With dam reconstruction

a. Badger Creek

244,150 kokanee (eyed eggs)	=	1,225

b. Bitch Creek

50,000 kokanee (eyed eggs)	=	250

c. Teton Reservoir

210,000 kokanee (fry)	=	3,750
158,000 lake trout (fry)	=	2,225
2,000 lake trout (fingerlings)	=	2,805
300,000 young-of-the-year cutthroat for 2 yrs	=	4,000
500,000 kokanee (fingerlings) for 8 years	=	11,300
8 helicopter flights	=	36,000
Subtotal		$61,555

61,555

B. Teton Dam to forks of Teton

1. Without reconstruction of Teton Dam

3,250 cutthroat trout (650 lbs) catchables	9,750

2. With reconstruction of Teton Dam

3,250 rainbow (650 lbs) catchables	9,750
100,000 yearling cutthroat annually provided by new hatchery facilities at American Falls hatchery	23,000
Transportation & planting	3,000
Subtotal	45,500

45,500

C.	Texas Slough		
	1. 4,930 rainbow (29 lbs) (fry)	435	
D.	Dry Bed		
	1. 52,000 rainbow (300 lbs) (fry)	4,500	
E.	Spring Creek		
	1. 35,200 rainbow (200 lbs) (fry)	3,000	
	Estimated total restocking costs Without dam	149,435	
	With dam	114,990	
VI.	Fish hatchery - Construction*		2,000,000
	Estimated total fishery compensation costs		
	TOTALS of I-VI, rounded		$14,500,000

* O&M @ 100,000/yr for life of project (100 years)

Big Game

Restoration, Mitigation and Compensation

Compensation efforts should be designed to replace irretrievable habitats and direct animal losses and to rehabilitate habitats that have a potential for some degree of recovery.

AREA I:

Compensation required with reconstruction of the dam would be identical to the original mitigation recommendations for big game (Appendix A), except that much of the land which was designated for game management downstream from and adjacent to the dam has been destroyed. This 960 acre parcel would have to be surveyed, and ruined lands should be replaced at an off-site location. To compliment other phases of the mitigation plan, we recommend that the additional lands be acquired in the Tex Creek Game Range.

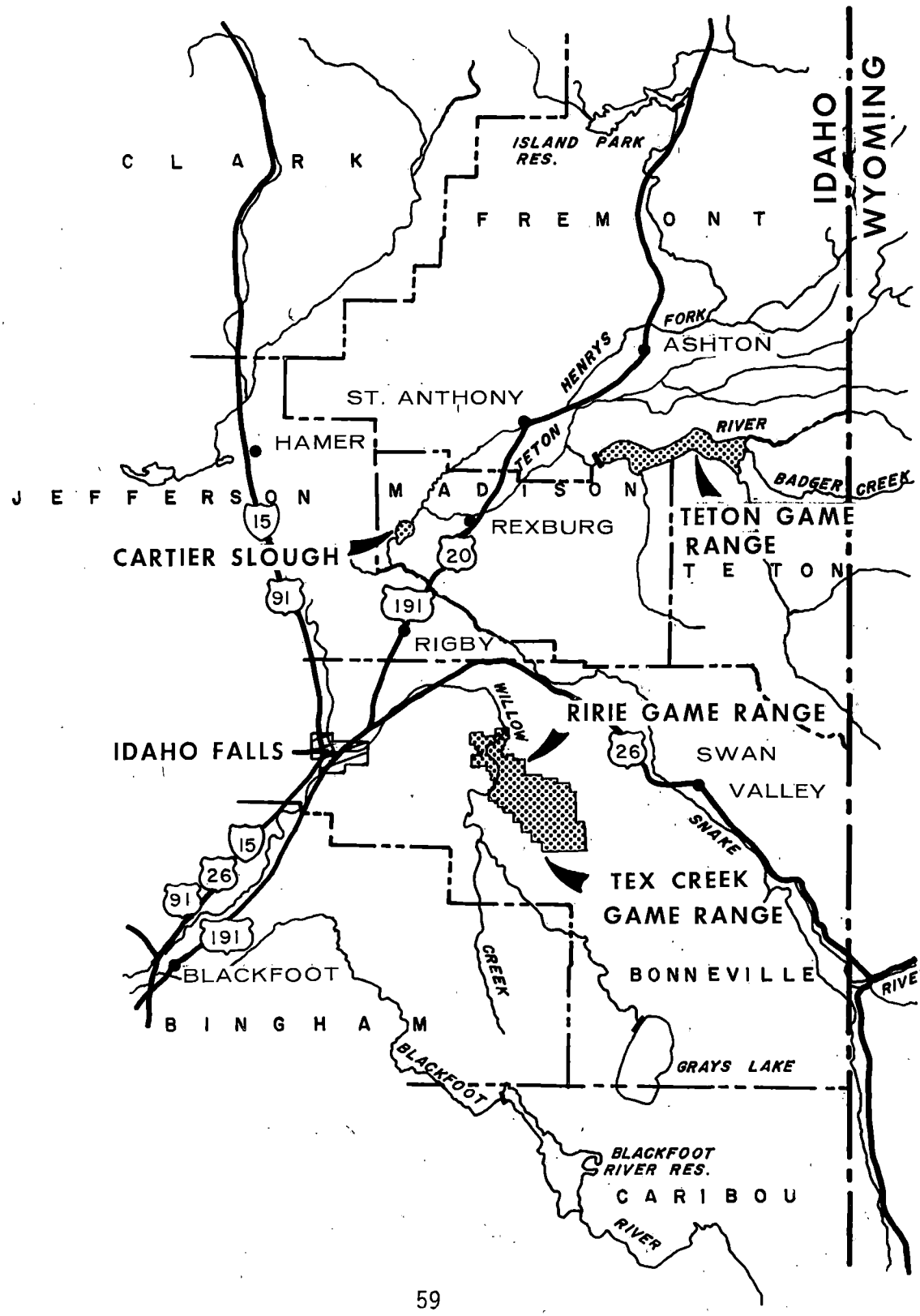


Figure 25. Locations of Teton, Ririe and Teton Dam Game Refuge

Losses resulting from the dam failure are, in most instances, equal to or greater than those associated with dam construction and must be compensated for.

Because of the slides and other detrimental effects, the big game habitat which existed prior to dam construction has been destroyed or significantly reduced for the next 50 years. Since these losses are basically the same as those occurring during inundation, the original mitigation measures should remain in effect.

Therefore, the Tex Creek program should be continued with or without dam reconstruction.

Revegetation and habitat restoration measures necessary for fisheries would stabilize the area and help a portion of the area to regain approximately 40 percent of its carrying capacity in 50 to 100 years.

AREA II - VIII: Teton Dam to American Falls Reservoir.

Habitat loss, either from direct or indirect causes, is the major item requiring compensation. Lost animals cannot be replaced nor populations be enlarged until adequate habitats are re-established to support them. Much of the identified lost habitat is in stream bottoms, which under normal circumstances could recover in time. However, the debris removal, land clearing, and channel filling activities funded under SCS 216 programs have changed the physical character of the land so as to permit agricultural uses which will prevent natural restoration.

Because of the area of bottom lands required to replace the carrying capacity of lost big game habitat and the extensive restoration needed to offset 216 program actions, it would be necessary to seek off-site compensation.

Because of land ownership patterns, previous compensation from Teton Dam and Ririe Dam Projects, the Tex Creek Game Range area offers the best opportunity to replace big game losses with minimum economic outlay. Seven private parcels of land, combined with State and Federal lands not included in the present game range, are recommended for purchase or transfer (Figure 26). Figure 26 also lists present landowners; those asterisked are known willing sellers.

Once purchased, the O&M previously designated for the game range would have to be increased proportionately for management of increased lands.

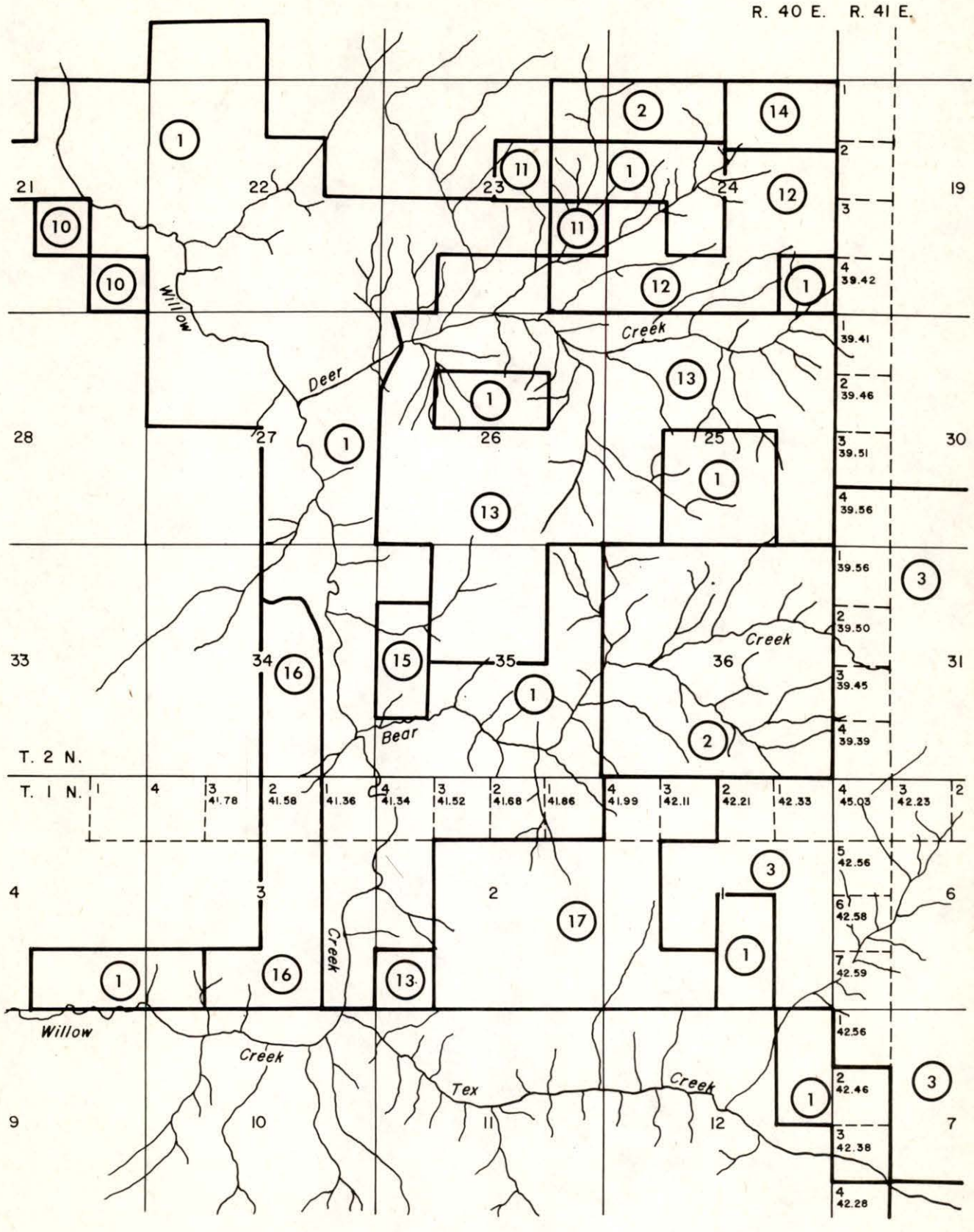


Figure 26.
Tex Creek big game mitigation lands

(10)	John Campbell and Sons 780 Horvin Avenue Idaho Falls, ID	80 acres
(11)	Robert Harris Route 2, Box 120 Rigby, ID	80 acres
(12)	Wendell Harris Box 302 Ririe, ID	360 acres
(13)	Quarter Circle O %Lulu Ferebauer, Sec. Route 2, Box 491 Idaho Falls, ID	1320 acres
(14)	Cleon Harris Route 2, Box 120A Rigby, ID	80 acres
(15)	Bessie I. Dunn 118 S. Fairmont Lodi, CA 95240	80 acres
(16)	Harold Hansen Box 146 Iona, ID	320 acres
(17)	Browns Meadow Creek Ranch, Inc. %Rex Brown 1171 E. 25th Idaho Falls, ID	600 acres
(3)	Tex Creek Game Range	
(2)	State Department of Lands	
(1)	U.S. - B.L.M. and Ririe Take	
	Total Private	2840 acres

Restoration of acquired lands should include fence removal, fence building, and some road realignment.

Big Game Mitigation Costs:

Acquisition	
2,840 acres of private lands @ 400/ea:	$1,136,000
($/acre based on inquiries of present land values in area)	
Transfer State of Idaho lands:	
Restoration:	35,000
TOTAL	$1,171,000

O&M: Estimated @ $20,000 annually

Total O&M:

100%	1 - 10 yrs	@ 20,000 =	$ 200,000
80%	10 - 20 yrs	@ 16,000 =	160,000
70%	20 - 25 yrs	@ 14,000 =	70,000
60%	25 - 50 yrs	@ 12,000 =	300,000
		TOTAL	$ 730,000

Percentage based on percent of lost big game habitat expected to recover over time periods.

Estimated Total Big Game Mitigation:

Acquisition	$1,171,000
Restoration	35,000
O&M	730,000
TOTAL	$1,936,000

UPLAND GAME ANIMALS, FUR ANIMALS AND NON-GAME BIRDS AND MAMMALS

Compensation

Compensation for losses of upland game, fur animals and non-game birds and mammals and their habitats are taken into consideration and would be adequately met in the mitigation measures addressed for waterfowl and shorebirds.

Compensation for lands lost through Senate Bill 1202:

Senate Bill 1202, if passed, would make 6,000 acres of ERDA lands in Idaho available to the farmers who lost their farms in the Teton disaster. The bill makes the land available in 160 acre plots for purchase at fair market value. If eligible farmers do not exercise their opportunities in three years, the tract reverts to ERDA.

Wildlife resources on the recommended 6,000 acres of land include a resident population of sage grouse, sage grouse strutting grounds, and brood rearing areas. The area is immediately adjacent to a major antelope migration route and supports part of the migrating population. There is a small resident population of antelope, and during winters with limited snowfall, it is used as an antelope wintering area.

The proposed lands encompass a portion of the second largest nesting population of ferruginous hawks in North America.

Loss of these wildlife lands is indirectly attributable to the Teton Dam failure and therefore must be compensated.

Compensation should include replacement of upland game lands capable of supporting, or having the potential after restoration and under management, of supporting additional animal numbers with equal breeding and brood rearing potential to replace the lost populations and their future progeny. It should also replace big game habitats with sufficient lands to support additional animal numbers equal to those lost. Private lands which have interrupted big game migrations in other areas should be considered if they meet the upland and resident big game requirements.

One site, within the same geographical area, has big game and upland game potential and has been considered for acquisition by the Idaho Department of Fish and Game in previous years. At one time, it supported good populations of sharp-tailed grouse, some sage grouse, mule deer, and was part of a mule deer and elk migration route. These populations have been seriously reduced and the migration corridor severed by agricultural developments in recent years.

Land description:

T.8N., R.38E., Parts of Sections 1, 2, 3, 4, 9, 10, 11, 12, 13, 15, and 22.

T.8N., R.39E., Parts of Sections 2, 3, 7, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 27, 28, and 29.

Estimated total acres: 5,000 - 6,000

A. Cost estimates

Acquisition:

Approximate real estate values of lands:

Grasslands	$100+/acre
Agricultural	$900 - 1,000/acre
Estimated average	$500/acre
5,500 acres @ $500/acre	$2,750,000

Restoration:

Revegetating lands to wildlife habitat	*$100,000

* Based on Teton Canyon Revegetation Plan costs

O&M:

Initial posting	$ 5,000
Year 1	10,000
Year 2	5,000
Year 3	3,000
Years 4 and 5	5,000
TOTAL O&M	$28,000

Total S. 1202 Compensation: $2,878,000

WATERFOWL AND SHOREBIRDS

Restoration, Compensation and Mitigation

AREAS I - VIII:

Many losses to waterfowl habitat are permanent or will take so long to recover naturally that they cannot be included in future resource evaluations, and are therefore considered an irretrievable loss. Additional habitat losses occurred; however, it is felt the areas affected have the ability to recover naturally within a reasonable period of time.

Measures to offset or mitigate the impacts could be accomplished on most of these lands by management practices.

Compensation by acquisition of replacement lands within the flood plain would be much less expensive than trying to reclaim all lands destroyed by the flood. Acquisition would also benefit wildlife sooner, be more effective in restoring the resource to its pre-flood level, and would replace lost hunting areas and offset hunter-day losses which were estimated to have a 50 year economic value of 6.3 million dollars.

Three areas which have the potential for increasing waterfowl production and general use are Roberts Slough, Sterling wetlands and Henry's Fork bottoms.

1. Roberts Slough

   Roberts Slough is a 545 acre half-moon shaped slough, originally a bend in the Snake River (Figure 27). Until recent years, it remained open at both ends, and fresh-water flowed through the slough during periods of high runoff in the Snake River. Excellent waterfowl, shore-bird, and marsh bird production existed. In recent years, the north end of the slough was closed, and the marsh has deteriorated. Its major source of water at this time is groundwater.

   Runoff water from Market Lake is presently diverted directly into the Snake River. Changing this diversion through Roberts Slough would increase the spring water level north of Highway 48, increasing the available waterfowl, marsh, wading, and shorebird nesting capacity by 40 percent. Side benefits would be the improved capability of the slough to sustain a freshwater fishery and public health benefits to the town of Roberts by eliminating stagnant water.

Existing private water rights would not be affected by management of the slough for wildlife.

At present, the slough supports nesting white-faced glossy ibis, a species of concern being considered for the Department of Interior's list of threatened or endangered species. The slough also supports nesting colonies of black tern and western grebe. Waterfowl production is fair to good. According to local residents and past Department of Fish and Game reports, levels of use have been reduced by half.

Acquisition, restoration, and proper management practices could bring the area back to optimum capability. These lands would then compensate for lands lost in Teton Canyon from the dam to Hog Hollow.

A. Cost Estimates:

Acquisition:

Based on an estimated cost of $500 per acre for 545 acres.

$ 272,500

B. Restoration:

Installation of a freshwater inflow would be needed. Market Lake wastewater runoff is available near Roberts Slough. Transfer of this through an open channel into the north end of the slough and a modification of the elevation of the outflow culvert would provide the freshwater inflow.

Freshwater intake:		$ 40,000
Outtake modifications:		8,000
	TOTAL	$ 48,000

C. O&M:

To guarantee a management program, the area should be assigned to the Idaho Department of Fish and Game Market Lake Wildlife Management Area.

Estimated annual O&M: $ 10,000

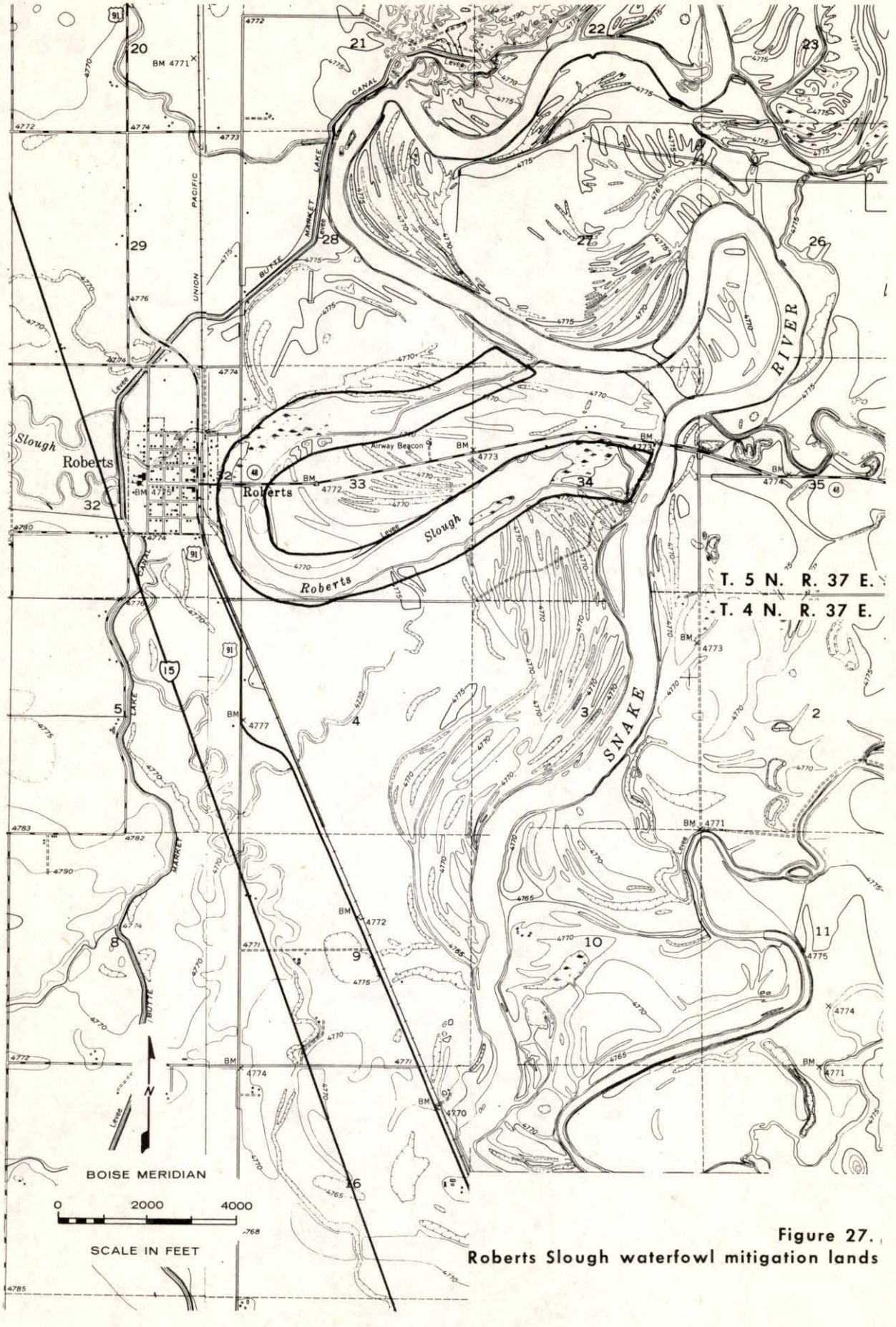


Figure 27.
Roberts Slough waterfowl mitigation lands

2. Sterling wetlands

In T.4S., R.32E., B.M. and T.5S., R.32E., B.M., extensive salt-grass-marsh bottom is presently under private ownership and managed for cattle (Figure 28). Historically, the land was part of the outstanding waterfowl production area in the Fort Hall bottoms. Construction of American Falls Reservoir and subsequent private land practices have reduced the total acres of wetlands to a minute portion of the original amount.

Portions of these lands still retain bogs and marshes and have the potential to return to outstanding waterfowl, marsh and shorebird nesting and loafing habitat.

These lands have the potential to produce approximately the same waterfowl benefits as the waterfowl habitats lost due to the flood. Compensation for wetlands lost on the North and South Forks of the Teton River, South Fork Snake, and main Snake would require acquisition of approximately 3,100 acres of Sterland wetlands in their present condition.

A. Cost Estimate:

Acquisition: Based on a value of $500 per acre for 3,100 acres.

$1,550,000

B. Restoration:

Before any type waterfowl management program could be initiated to return these lands to waterfowl habitat, an extensive restoration program would be necessary.

Fence removal: 120 man-days @ $50.00 =	$ 24,000
Fence construction: 5 mi @ $1,500/mi =	7,500
Dike construction: 2,000 ft using 20,000 cu yds @ $75.00/ cu yd =	15,000
Goose nesting islands: 100 islands @ $100 ea =	10,000
Goose nesting platforms: 100 platforms @ $75.00 ea	7,500

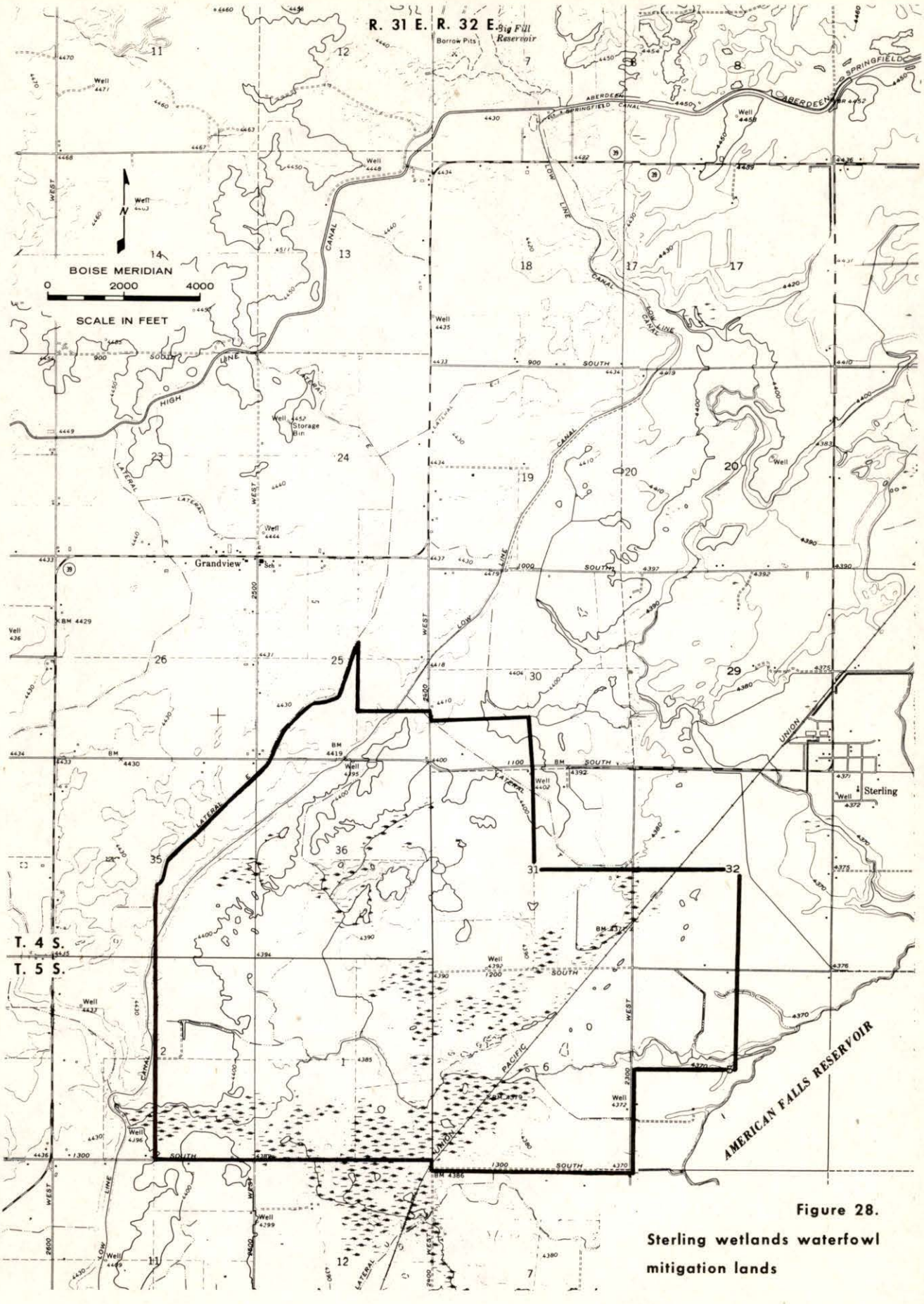


Figure 28.
Sterling wetlands waterfowl mitigation lands

C. O&M:

Annual O&M would be limited as the area would best function as a lightly managed area. Based on Idaho Department of Fish and Game costs for other areas, O&M would be approximately $30,000 per year.

3. Henry's Fork bottoms

Acquisition, restoration, and management of a third area in the Henry's Fork bottoms along with the other two areas previously mentioned would be adequate compensation for the waterfowl, shorebirds, upland game, fur animals, and non-game bird and mammal losses. Many of these lands were cleared of native vegetation, wetlands were drained or filled, and land use practices changed to agricultural uses during the flood rehabilitation program.

Accelerated agricultural practices would not only prevent the area from returning to its pre-flood condition but would continue to diminish the remaining wildlife values. Had the flood not occurred, it is likely that the landowners could not have afforded to clear these lands. If wetlands in the Henry's Fork and South Fork Teton Rivers are not protected and restored, the waterfowl, upland bird, fur animal, and non-game species losses will be increased and more off-site compensation would be required.

Acquisition and restoration of the following private lands would insure their return to a natural state and obviate additional off-site compensation (Figure 29).

T.7N., 39E.
- Sec. 28 - 93 acres
- Sec. 27 - 375 acres
- Sec. 33 - 175 acres
- Sec. 34 - 434 acres

T.6N., R.39E.
- Sec. 3 - 75 acres
- Sec. 4 - 140 acres
- Sec. 5 - 65 acres
- Sec. 8 - 514 acres
- Sec. 9 - 430 acres
- Sec. 16 - 120 acres
- Sec. 17 - 65 acres
- Sec. 20 - 290 acres

TOTAL 2,776 acres

A. Cost Estimates:

Acquisition based on a cost of $400 an acre for 2,776 acres.

$1,110,400

B. Restoration:

Restoration of the area for waterfowl, upland game, furbearers, and non-game species would include revegetation, and some pothole and slough cleaning (for willow propagation and to create open water necessary for ducks).

1. Revegetation:
   Cutting, greenhousing and planting a bottomland shrub mix of willow, dogwood, wild rose, and alder for 1,000 acres, using a planting rate of 200 plants to an acre.

   Total estimated cost @ ¢.40 per plant average X 200 plants X 1,000 acres.

   $ 80,000

2. Pothole and slough cleaning - D8 cat crawler work.

   Approximately $ 20,000

3. Fence removal - approximately $ 3,000

   Total restoration $ 183,000

Estimated total cost: $1,293,400

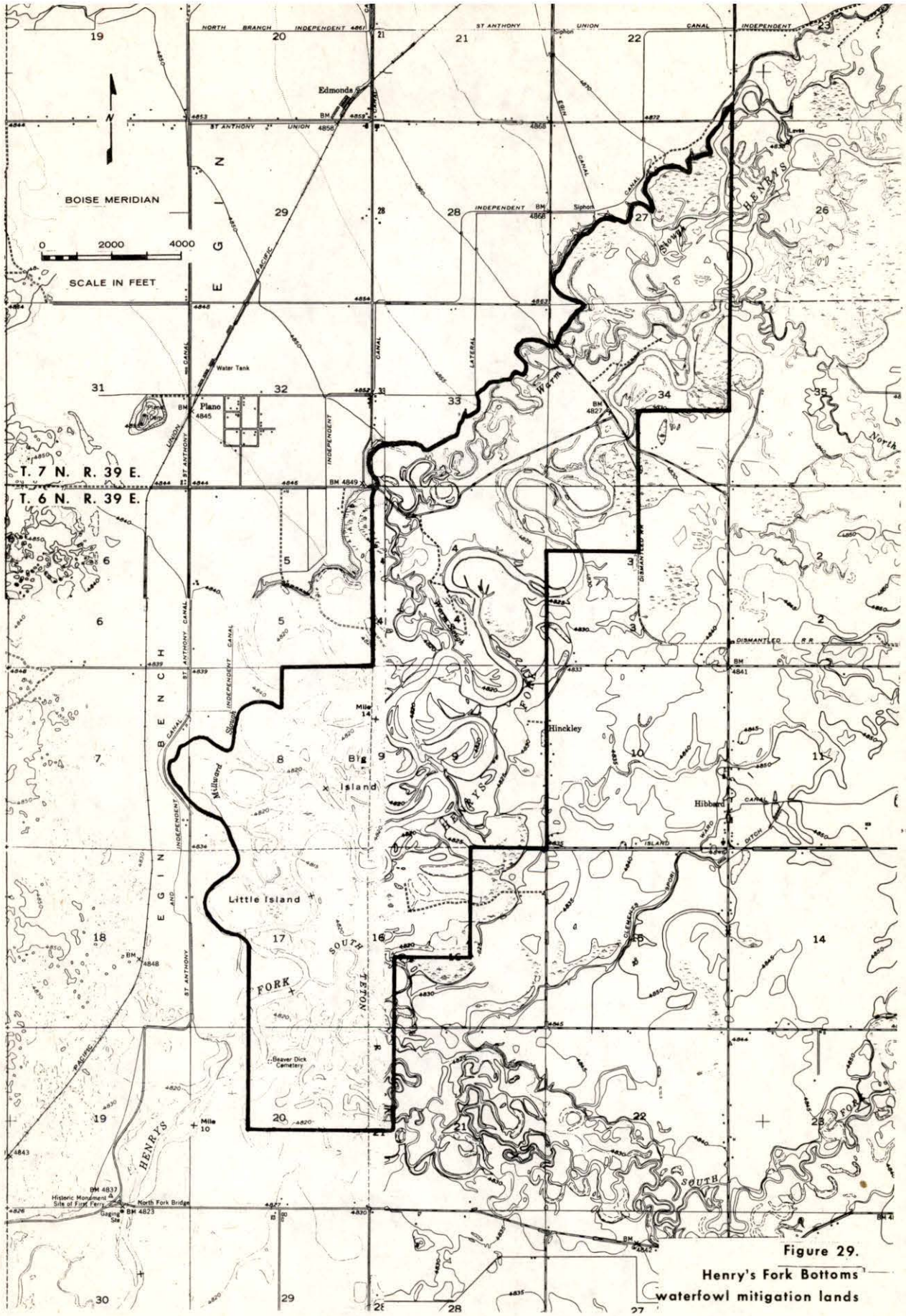


Figure 29.
Henry's Fork Bottoms waterfowl mitigation lands

Because of channel siltation and potential flooding with relatively low spring levels, some management application would be necessary to insure goose nesting success.

A series of nesting platforms, starting in the Henry's Fork below St. Anthony and extending downstream to the confluence with the South Fork Snake River should be constructed. Approximately 150 pair of nesting geese are counted throughout this stretch annually. Because of distance, suitability, and expected use, 150 nest platforms should be sufficient. Placement of these structures should be coordinated with Idaho Department of Fish and Game.

A. Costs:

Total estimated cost: 150 units @ $150.00 per unit $ 22,500

Five (5) year maintenance @ $7,500 annually: $ 37,500

Total waterfowl compensation costs:

Land acquisition	$2,933,000
Restoration of wetlands	215,000
Goose nest platforms in Henry's Fork	97,500

O&M prorated down over 50 years from $60,000 first year need.

Years 1 - 10	$600,000
10 - 20	450,000
20 - 25	175,000
25 - 50	475,000
TOTAL	$1,700,000

TOTAL $4,946,200

APPENDIX

TABLE 1: FISH STOCKING RECORDS FOR 1976 SPORT FISH SEASON - IDAHO DEPARTMENT OF FISH AND GAME

DATE	SITE	SPECIES	NO. STOCKED	WT (LBS)
10/11/75	Badger Creek	kokanee (eyed eggs)	118,910	-
10/30/75	Badger Creek	kokanee (eyed eggs)	105,240	-
6/4/76	Bitch Creek	kokanee (fry)	52,164	138
12/11/75	Above Reservoir in Teton River	kokanee (fry)	210,000	70
4/12/76	Spring Creek, near Independence Canal	rainbow	35,200	200
4/20/76	Dry Bed, below Lewisville	rainbow	24,140	142
4/21/76	Dry Bed, below Lewisville	rainbow	9,860	58
4/21/76	Texas Slough	rainbow	4,930	29
5/5/76	Dry Bed, below Lewisville	rainbow	17,000	100
5/27/76	Teton Reservoir	lake trout	97,917	381
6/2/76	Teton Reservoir	lake trout	60,240	240
6/2/76	Teton Reservoir	lake trout	2,000	187
6/2/76	Teton River below dam	rainbow	1,500	300
6/3/76	Teton River below dam	rainbow	1,750	350

TABLE 2: MAN-DAYS OF ANGLER LOSS DUE TO TETON DAM FAILURE OVER NEXT 100 YEARS (1976-2075)

AREA	ANGLER DAYS LOST[1/]					
	1976	1977-80	1981-90	1991-2000	2001-75	TOTAL
Teton Dam Reservoir	3,500	188,705	674,700	1,081,050	9,157,500	11,105,455
Teton Dam to distributary forks	6,000	32,000	100,000	100,000	750,000	988,000
North Fork to Teton	200	800	2,000	2,000	7,500	12,500
South Fork Teton	450	1,200	1,000			2,650
Henry's Fork to American Falls	6,500	4,000	10,000	10,000	75,000	105,5000
Total Man-days	13,650	226,705	787,700	1,193,050	9,990,000	12,214,105

1/ Computed from The Fish Populations and Fishery in the Teton River, 1974, Irving, Ellie, and Bjorn and from conversations with personnel from the Idaho Department of Fish and Game and the Fort Hall Indian Reservation.

TABLE 3. VALUES OF ANGLER-DAYS LOST DUE TO TETON DAM FAILURE OVER THE NEXT 100 YEARS (1976-2075)

AREA	DOLLAR VALUE OF LOST ANGLER DAYS 1976	77-80	81-90	91-2000	2001-75	TOTAL
*Teton Dam Reservoir	10.5	566.1	2,024.1	3,243.1	27,472.5	33,316.3
**Teton Dam to forks of North & South Teton Rivers	54	288	900	900	6,750	8,892
**North Fork to Teton	1.8	7.2	18	18	88.9	123.9
**South Fork Teton	4.0	10.8	9			23.8
**Henrys Fork to American Falls	58.5	36	90	90	889.2	1,173.7
TOTAL $ (thousand dollars)	128.8	908.1	3,041.1	4,251.1	35,200.6	43,529.7

* Values taken from Principles and Standards. $3.00 per fisherman day.

** Values taken from Principles and Standards. $9.00 per fisherman day. From the interim schedule of recreation day monetary values contained in Principles and Standards for Planning Water and Related Land Resources, Federal Register, Volume 38, No. 174, Part III, Water Resources Council, September 10, 1973.

TABLE 4: PRE-FLOOD BIG GAME DISTRIBUTION THROUGH FLOOD AFFECTED AREAS.

AREA II:	Teton River, Teton Dam to just downstream from Newdale, Idaho.[1/]	
	Mule deer (resident population)	15 to 25
	White-tailed deer	0 to 2
	Elk (winter only)	0 to 5
AREA III:	North and South Fork Teton River.	
	Mule deer (resident population)	5 to 15
	White-tailed deer	0 to 5
	Moose	1 to 3
	(All animals located in Lower South Fork near Henry's Fork bottoms)	
AREA IV	North (Henry's) Fork, Snake River south of Parker, Idaho, to the confluence with the South Fork Snake River.	
	Mule deer and white-tailed deer	50 to 75
	Moose	6 to 8
AREA V	South Fork Snake River, Highway 191 bridge to confluence with North Fork Snake River.	
	Mule deer and white-tailed deer	10 to 20
	Moose	2 to 5

1/ October 24, 1961, Don Trupp, rancher with a ranch just below Teton Damsite, estimated 20 deer and three elk were present in Teton Canyon near his ranch. This is evidently a common occurrence as he stated there are always a few deer utilizing this area.

TABLE 4: Continued

AREA VI	Mainstem Snake River confluence of North and South Forks to Roberts, Idaho.	
	Mule deer and white-tailed deer	40 to 50
	Moose	6 to 8
AREAS VII & VIII	Mainstem Snake River, Shelley to American Falls Reservoir.	
	Mule deer	150
	White-tailed deer	0 to 10

TABLE 5: BIG GAME LOSSES

AREAS	MOOSE	MULE DEER & WHITE-TAILED DEER	TOTALS
I	0	0	0
II	0	20	20
III	0	5 to 10	5 to 10
IV - VI	4 (calves)	30 to 40 (fawn) 10 to 20 (adult)	34 to 44 10 to 20
VII - VIII	0	40	40 to 40
TOTAL LOSSES	4	105 to 130	109 to 134

TABLE 6. MAN-DAYS OF BIG GAME HUNTING LOST AS A RESULT OF THE TETON DAM FAILURE OVER FIVE YEARS (1976-1980)

AREAS	MAN-DAYS OF HUNTING LOST PER YEAR					TOTAL MAN-DAYS LOST
	1976	1977	1978	1979	1980	
I through IV	560	500	250	100	50	1,460
V and VI	400	350	200	100	50	1,100
TOTALS	960	850	450	200	100	2,560

Average man-days of hunting per animal unit of harvest times the annual harvest from the area computed from hunter report-card data. The area has a hunt restricted to archers, muzzle-loaders, and shotguns. Most shotgun hunting is incidental with other hunting use of the area.

TABLE 7. DIRECT UPLAND GAME LOSSES

SPECIES	ACRES OF HABITAT AFFECTED	LOSSES AREAS I-IV	LOSSES AREAS V-VI	TOTAL ANIMALS LOST
Pheasant	120,000	2,200	2,100	4,300
Huns	15,360	3,300	-	3,300
Doves	25,600	5,480	-	5,480
Grouse	5/per mi on 25 mi of river	125	-	125
Cottontail	56,000	5,480	4,100	9,580
TOTAL LOSSES		16,585	6,200	22,785

TABLE 8. MAN-DAYS OF UPLAND GAME HUNTING LOST AS A RESULT OF THE TETON DAM FAILURE OVER THE NEXT 50 YEARS (1976-2026) FOR ALL AREAS I THROUGH VI.

SPECIES	HUNTER-DAYS LOST PER YEAR							
	1976	1977	1978	1979	1980	1981	1982-2026	TOTAL LOST
Pheasant	4,100	3,700	2,100	1,000	200	150	5,500	16,750
Huns	125	125	75	30	10	10	450	825
Dove	1,200	200	200	200	200	200	3,700	5,900
Grouse	100	100	50	50	25	10	450	785
Cottontail	2,500	500	2,000	1,100	600	250	2,200	11,150
TOTALS	8,025	6,625	4,380	1,035	1,035	620	12,300	35,410

Computed from annual Hunter Questionaire Data (1972). At least a 25 percent increase in total hunter use could have been expected over the next 54 years of study, making the total loss closer to 43,500 hunter-days of use.

1970 National Survey of Fishing and Hunting: Economic value of hunting: $9.73 per hunter day.

TABLE 9: LOSS OF FUR ANIMALS AND MARKET VALUE OVER A FIVE YEAR RECOVERY PERIOD.

SPECIES	NO. LOST	1976 MARKET VALUE	ESTIMATED MARKET VALUE LOST OVER RECOVERY PERIOD			TOTAL ESTIMATED MARKET VALUE LOST
			1977	1978	1979	
Beaver	200	4,500	2,250	565	70	7,385
Muskrat	2,500	8,925	4,465	1,115	140	14,645
Mink	460	6,900	3,450	870	105	11,325
Weasel	50	125	65	-0-	-0-	190
Skunk	500	1,750	875	220	35	2,880
Raccoon	100	1,500	750	180	30	2,460
Fox	100	3,500	1,750	420	105	5,775
Coyote	25	1,250	650	150	50	2,100
Bobcat	10	2,750	1,375	550	-0-	4,675
TOTALS	3,945	$31,200	$15,630	$4,070	$535	$51,435[1/]

[1/] Fur prices based on 1975-76 market values.

TABLE 10: AREAS I AND II, WINTER WATERFOWL AND BREEDING PAIRS COUNTS

SPECIES	(1)1960 NUMBER	1975 NUMBER
Mallard	1,260	586
Wood duck	110	--
American goldeneye	150	498
Misc. ducks	275	4
Canada geese	85	165
Trumpeter swan	12	--
Mergansers	20	28
Redheads	30	--
TOTAL	1,942	1,281

(1) Includes Teton Valley, which has greatest portion of populations.

AREAS III AND IV, LOWER (HENRY'S) FORK SNAKE RIVER TO ST. ANTHONY TO THE CONFLUENCE WITH THE SOUTH FORK SNAKE RIVER.

YEAR	BREEDING PAIRS GEESE	NON-BREEDERS GEESE	TOTAL GEESE
1976 (3/30)	40	18	98
1975	31	--	62
1974	23	--	46
1973	28	10	66
1972	30	--	60
1971	41	--	82

AREA V: LOWER SOUTH FORK, SNAKE RIVER, LORENZO TO CONFLUENCE WITH THE NORTH FORK SNAKE RIVER.

YEAR	BREEDING PAIRS GEESE	NON-BREEDERS GEESE	TOTAL GEESE	TOTAL MALLARDS
1976 (3/30)	32	35	99	---
1975				
1973	16	30	62	309

AREA VI: MAINSTEM SNAKE RIVER CONFLUENCE OF NORTH FORK AND SOUTH FORK TO IDAHO FALLS.

YEAR	BREEDING PAIRS GEESE	NON-BREEDERS GEESE	TOTAL GEESE
1976	58	257	373
1975	23	---	---
1974	9	---	---
1973	26	---	---
1972	10	---	---
1971	--	---	---

AREA VII: MAINSTEM SNAKE RIVER, IDAHO FALLS TO BLACKFOOT

YEAR	BREEDING PAIR GEESE[1/]	NON-BREEDERS	TOTAL GEESE	TOTAL MALLARDS	TOTAL DUCKS
1965	--	--	44	4,540	6,055

1/ Because of low numbers and lack of habitat, this area is not systematically censused.

AREA VIII: MAINSTEM SNAKE RIVER BLACKFOOT TO AND INCLUDING AMERICAN FALLS RESERVOIR

1976	20	50	90		
1975	38	66	142		
1974	5	12	22		
1965	--	--	3,722	30,480	51,705

TABLE 11: CANADA GOOSE POST-FLOOD POPULATIONS.

AREA IV: Lower North Henrys Fork Snake River, St. Anthony to the confluence with the South Fork Snake.

DATE	ADULT GEESE	GOSLINGS
June 18, 1976	25	0*
June 29, 1976	0	0
July 12, 1976	2	0

*Breeding loss assumed to be 100%.

AREA V: Lower South Fork, Snake River, Heise to confluence with North Fork Snake River.

DATE	ADULT GEESE	GOSLINGS
June 18, 1976	15	0*
July 12, 1976	21	2

*Breeding loss estimated at 95 ± 3%.

AREA VI. Mainstream confluence of North Fork and South Fork to Idaho Falls.1/

DATE	ADULTS	GOSLINGS
June 18, 1976	40	0*
June 29, 1976	34	30
July 12, 1976	20	16

1/ Area includes Roberts and Battle Sloughs.

* Losses estimated at 75% of second nesting capability because of displacement and 60 ± 4% loss of total production.

AREA VIII: Mainstream Snake River to and including the grassy uplands to the north end of American Falls Reservoir.[1/]

DATE	ADULTS	GOSLINGS
June 18, 1976	36	41
June 29, 1976	167	99*
June 30, 1976[2/]	65	24
July 12, 1976	148	87
July 21, 1976	132	66
September 9, 1976	Unidentified	212

1/ Includes Big Springs Meadow and Fort Hall Bottoms.

2/ Boat census.

* Based on normal summer adult age ratios and average breeding success of breeding pairs. Losses were estimated at 40 ± 5%.

TABLE 12: ANNUAL ESTIMATED ECONOMIC VALUE OF LOST HUNTING DAYS (BASED ON 1972-75 DATA)

DUCKS

COUNTY	HUNTER-DAYS LOST	BIRDS/ DAY	NO. BIRDS	VALUE/ BIRD	TOTAL VALUE
Bingham	331	1.98	655	$20.79	$ 13,617.45
Bonneville	127	2.01	255	20.79	5,301.45
Jefferson	445	1.45	645	20.79	13,409.55
*Madison	5,000	1.84	9,200	20.79	191,268.00
Fremont	590	1.69	990	20.79	20.602.89
TOTAL	6,493		11,755		$244,199.34

GEESE

Bingham	48	.38	18	$168.72	$ 3,036.96
Bonneville	35	.57	20	168.72	3,374.40
Jefferson	149	.56	83	168.72	14,003.76
*Madison	1,200	.38	460	168.72	77,611.20
Fremont	332	.44	146	168.72	24,633.12
TOTAL	1,764		727		$1 22,659.44

* Four year average

TABLE 13: ESTIMATED 50 YEAR ECONOMIC VALUE OF LOST HUNTING DAYS

	1976	1977	1978	1979	1980	1981	1982-2026
DUCKS	100%	60%	60%	60%	60%	60%	30% x 45 yr
GEESE	100%	60%	60%	60%	60%	60%	30% x 45 yr

YEAR	DUCKS	GEESE
1976	$ 244,199.34	$ 122,659.44
1977	145,195.04	73,595.66
1978	145,195.04	73,595.66
1979	145,195.04	73,595.66
1980	145,195.04	73,595.66
1981	145,195.04	73,595.66
1982-2026	3,266,888.40	1,655,908.35
	$4,177,062.94	$2,146,546.09*

* TOTAL = $6,323,609.03

Taken from Colorado values for ducks and geese.

TABLE 14. PREFLOOD STRUCTURE OF THE TETON RIVER.

Average discharge near St. Anthony . . . . . 808 cfs

Drainage area . . . . . 900 square miles

Maximum discharge . . . . . 11,000 cfs Feb. 12, 1962

Minimum flow . . . . . 214 cfs Dec. 15, 1955

	RIVER MILES	GRADIENT	BOTTOM TYPE
a) South Fork Teton River	0 - 19.8 (Approx)	6.0 ft/mile (Approx)	fine rubble
b) North Fork Teton River	0 - 16.7	6.1 ft/mile	fine rubble
	16.7- 28.4	7.9 ft/mile	fine rubble
	28.4- 33.5	10.8 ft/mile	medium rubble
	33.5- 44.5	19.5 ft/mile	coarse rubble and boulders

MAP APPENDIX

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

DRUMMOND QUADRANGLE
IDAHO
7.5 MINUTE SERIES (TOPOGRAPHIC)

Mapped, edited, and publisfied by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1963. Field checked 1965

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

Fine red dashed lines indicate selected fence lines

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION
Medium-duty
Light-duty
Unimproved dirt
State Route

UTM GRID AND 1965 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

IDAHO
QUADRANGLE LOCATION

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR WASHINGTON, D.C. 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

DRUMMOND, IDAHO
N4352.5—W11115/7.5
1965
AMS 3771 IV NE—SERIES V883

95


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
LINDERMAN DAM QUADRANGLE
IDAHO
7.5 MINUTE SERIES (TOPOGRAPHIC)
AREA I
SCALE 1:24000
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL
ROAD CLASSIFICATION
Medium-duty
Light-duty
Unimproved dirt
State Route
Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS
Topography by photogrammetric methods from aerial photographs taken 1963. Field checked 1965
Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue
Fine red dashed lines indicate selected fence lines
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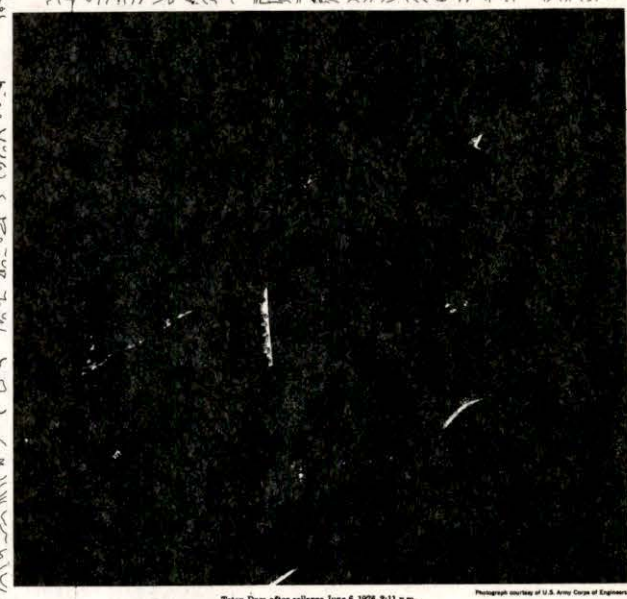
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST
LINDERMAN DAM, IDAHO
N4352.5—W11122.5/7.5
1965
AMS 3771 IV NW—SERIES V883
95a

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-565



Teton Dam after collapse June 6, 1976, 2:11 p.m.

Photograph courtesy of U.S. Army Corps of Engineers.

AREA I

AREA II

TETON DAM

Newdale

TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

The failure of the Teton Dam caused extreme flooding along the Teton River, Henrys Fork, and Snake River in southeastern Idaho on June 5–8, 1976. No flooding occurred downstream from American Falls Reservoir.

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The extent of flooding shown on the maps was obtained by field inspections and aerial photographs made during and immediately after the flood. There may be small isolated areas within the boundaries shown that were not flooded, but the identification of these sites was beyond the scope of the study. The elevation data shown are mean-sea-level elevations of high-water marks identified in the field.

Additional information on the magnitude of flood discharges, changes in ground-water levels, water quality, and other hydrologic effects resulting from the flood are available from the office of the U.S. Geological Survey in Boise, Idaho.

EXPLANATION

Area inundated by floodwater from Teton Dam

5018.1 ▲ High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by multiplex methods and by plane-table surveys 1949
Aerial photographs taken 1946

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
CONTOUR INTERVAL ON RIVER SURFACE 5 FEET
DOTTED LINES REPRESENT HALF-INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL

UTM GRID AND 1949 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

ROAD CLASSIFICATION

HARD-SURFACE ALL WEATHER ROADS	DRY WEATHER ROADS
Heavy-duty	Improved dirt
Medium-duty	Unimproved dirt
Loose-surface, graded, or narrow hard-surface	

U.S. Route ○ State Route

For sale by Branch of Distribution, U.S. Geological Survey, 1200 South Eads Street, Arlington, VA 22202 and Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225

TETON DAM FLOOD OF JUNE 1976, NEWDALE QUADRANGLE, IDAHO

By Herman A. Ray, Howard F. Matthai, and Cecil A. Thomas

Photograph by Parks Photo Service, Idaho Falls, Idaho.

Mouth of Teton River canyon, afternoon of June 6, 1976. Devastated community of Wilford, Idaho, in distance.

TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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AREA II

AREA III

4982.8
4960.3
4972.0
4948.4
4938.6
4932.9
4918.6
4979.0
4968.2
4981.1
4963.6
4972.3
4957.3
4927.6
4921.9

EXPLANATION

Area inundated by floodwater from Teton Dam

4979.0 High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Culture and drainage by multiplex methods from aerial photographs taken 1946

Topography by plane-table methods 1947–1948

Polyconic projection. 1927 North American datum 10,000-foot grid based on Idaho coordinate system, east zone

SCALE 1:24000

CONTOUR INTERVAL 10 FEET

DASHED LINES REPRESENT HALF-INTERVAL CONTOURS

DATUM IS MEAN SEA LEVEL

APPROXIMATE MEAN DECLINATION, 1948

ROAD CLASSIFICATION

HARD-SURFACE ALL WEATHER ROADS — Heavy-duty; Medium-duty

DRY WEATHER ROADS — Improved dirt; Unimproved dirt

Loose-surface, graded, or narrow hard-surface

U. S. Route ○ State Route

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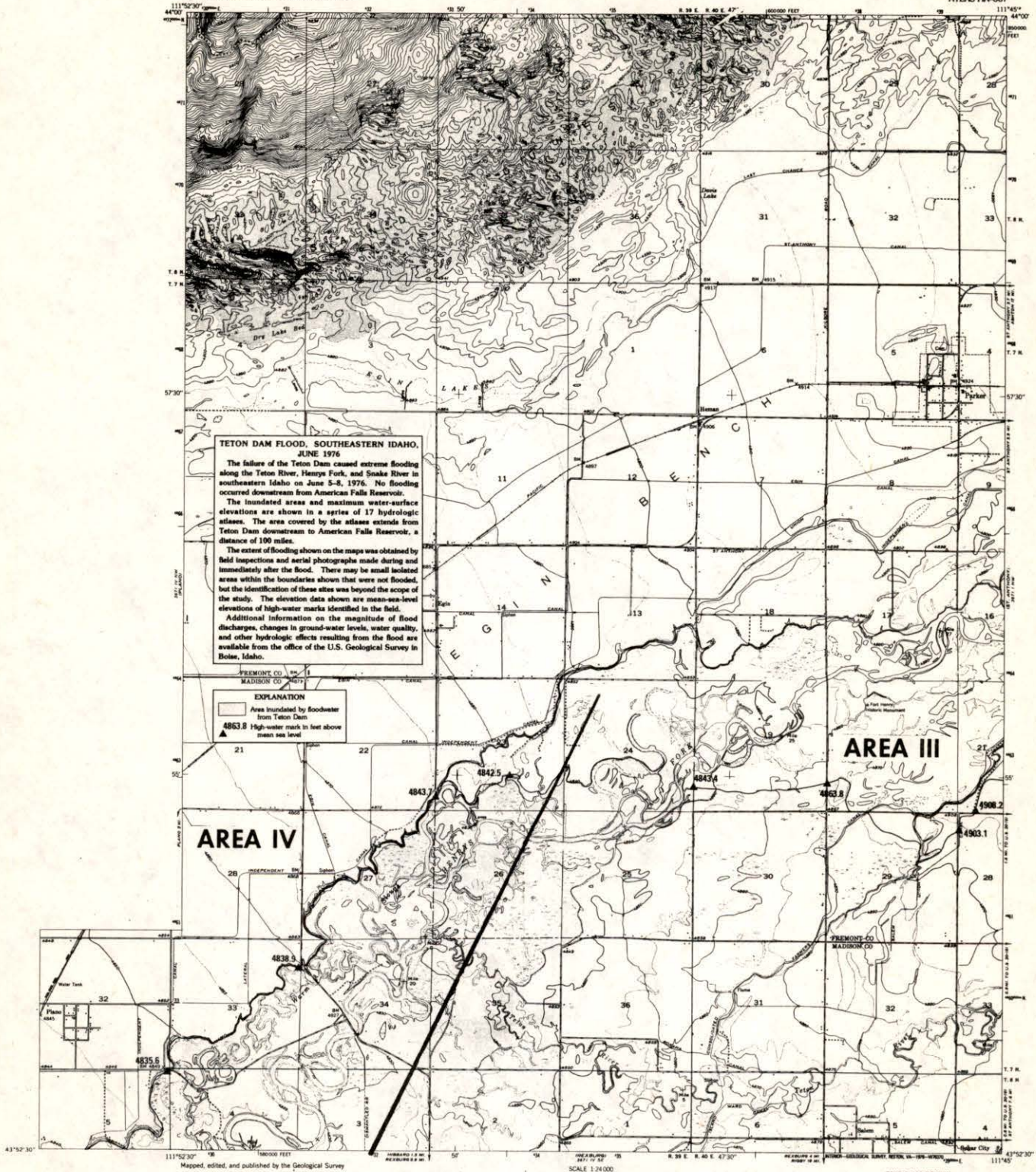
TETON DAM FLOOD OF JUNE 1976, ST. ANTHONY QUADRANGLE, IDAHO

By Cecil A. Thomas, Herman A. Ray, and Howard F. Matthai

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-567



Mapped, edited, and published by the Geological Survey
Control by USGS and USC&GS
Topography from aerial photographs by multiplex methods and by plane-table surveys 1948
Aerial photographs taken 1946
Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

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97a

TETON DAM FLOOD OF JUNE 1976, PARKER QUADRANGLE, IDAHO

By Cecil A. Thomas and Herman A. Ray

UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-568

AREA III

Sugar City, Idaho, inundated by Teton River about 6:45 p.m., June 5, 1976.

Photograph courtesy of U.S. Bureau of Reclamation.

TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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EXPLANATION

Area inundated by floodwater from Teton Dam

4913.5 High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by multiplex methods and by plane-table surveys 1951. Aerial photographs taken 1946

Polyconic projection. 1927 North American datum. 10,000-foot grid based on Idaho coordinate system, east zone

Dashed land lines indicate approximate locations

1000-metre Universal Transverse Mercator grid ticks, zone 12, shown in blue

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT HALF-INTERVAL CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

ROAD CLASSIFICATION

Heavy-duty ——— 4 LANE OR 2 LANE Light-duty ——— Medium-duty ——— 4 LANE OR 2 LANE Unimproved dirt - - - - - -

U.S. Route ◯ State Route

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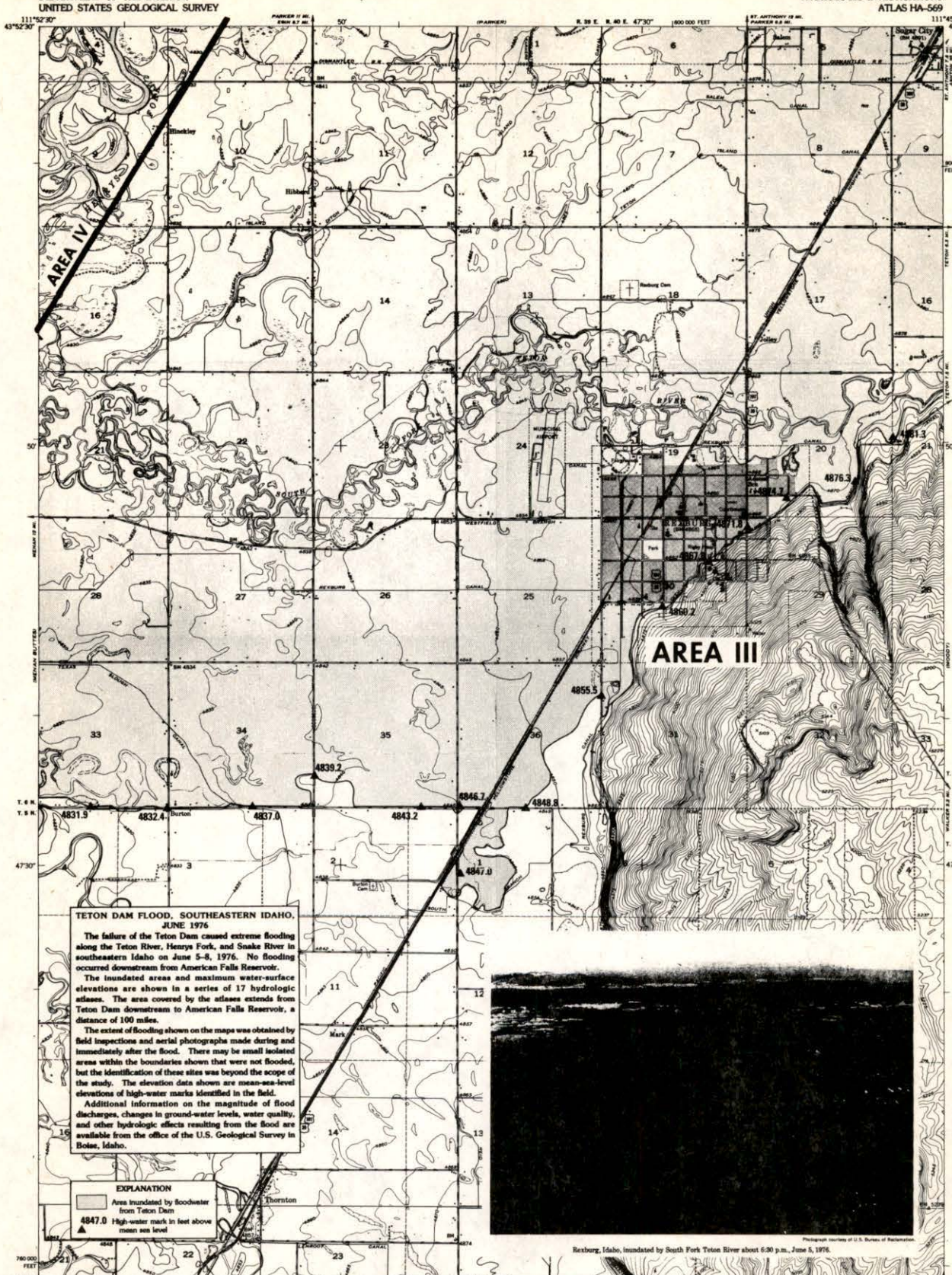
TETON DAM FLOOD OF JUNE 1976, MOODY QUADRANGLE, IDAHO

By William A. Harenberg and Bruce B. Bigelow

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-569



TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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EXPLANATION

Area inundated by floodwater from Teton Dam

4847.0 ▲ High-water mark in feet above mean sea level

Photograph courtesy of U.S. Bureau of Reclamation.

Rexburg, Idaho, inundated by South Fork Teton River about 6:30 p.m., June 5, 1976.

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Culture and drainage by multiplex methods from aerial photographs taken 1946

Topography by plane-table methods 1949

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone

Red tint indicates area in which only landmark buildings are shown

Dashed land lines indicate approximate location

APPROXIMATE MEAN DECLINATION, 1949

SCALE 1:24 000

CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION

HARD-SURFACE ALL WEATHER ROADS	DRY WEATHER ROADS
Heavy-duty	Improved dirt
Medium-duty	Unimproved dirt
Loose-surface, graded, or narrow hard-surface	

U. S. Route ○ State Route

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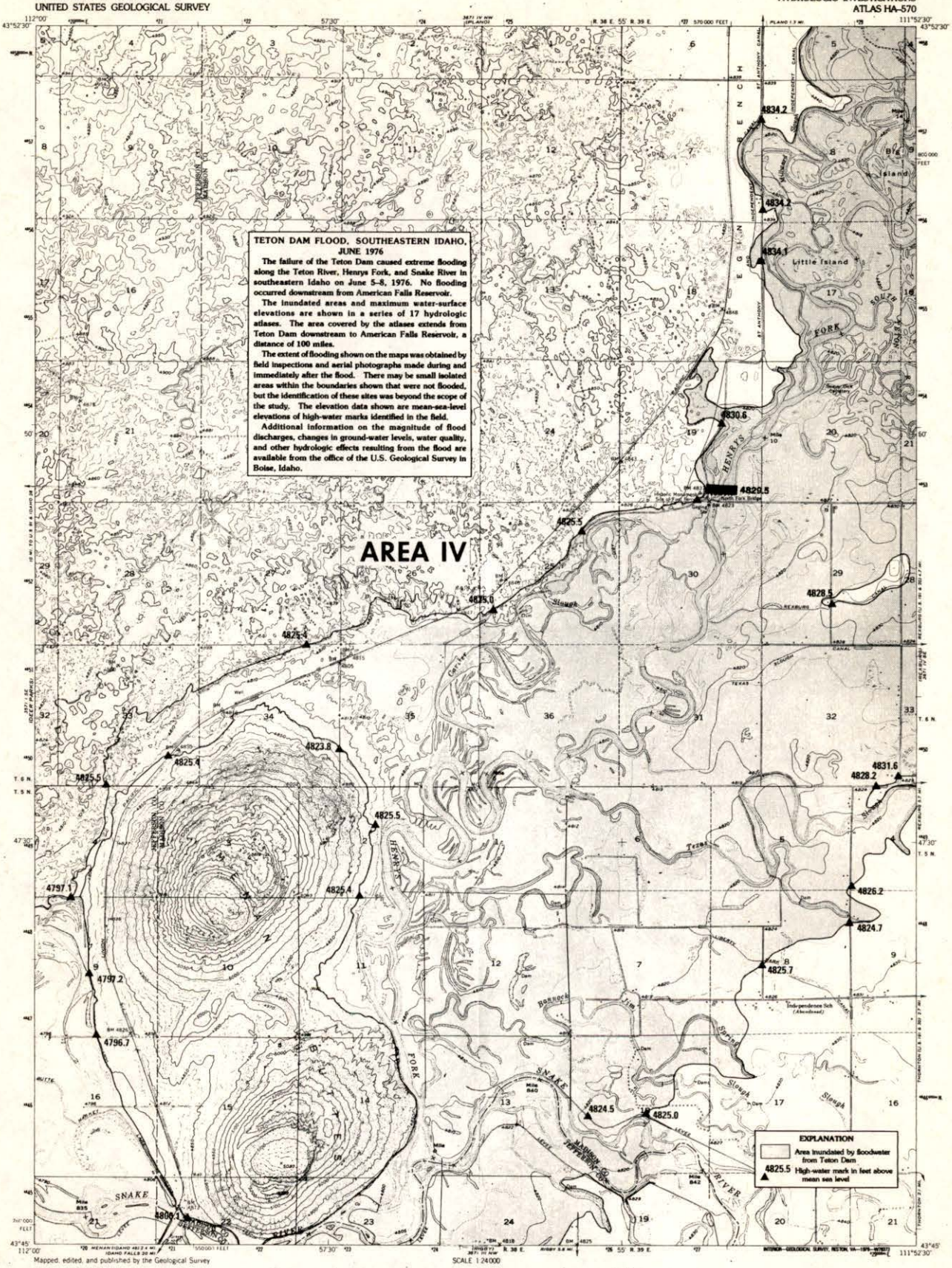
97c

TETON DAM FLOOD OF JUNE 1976, REXBURG QUADRANGLE, IDAHO

By William A. Harenberg and Bruce B. Bigelow

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-570



Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by Kelsh plotter and by plane-table surveys 1951. Aerial photographs taken 1950

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

Dashed land lines indicate approximate locations

SCALE 1:24000

CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT 5 FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

UTM GRID AND 1951 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

ROAD CLASSIFICATION
Light-duty ——— Unimproved dirt

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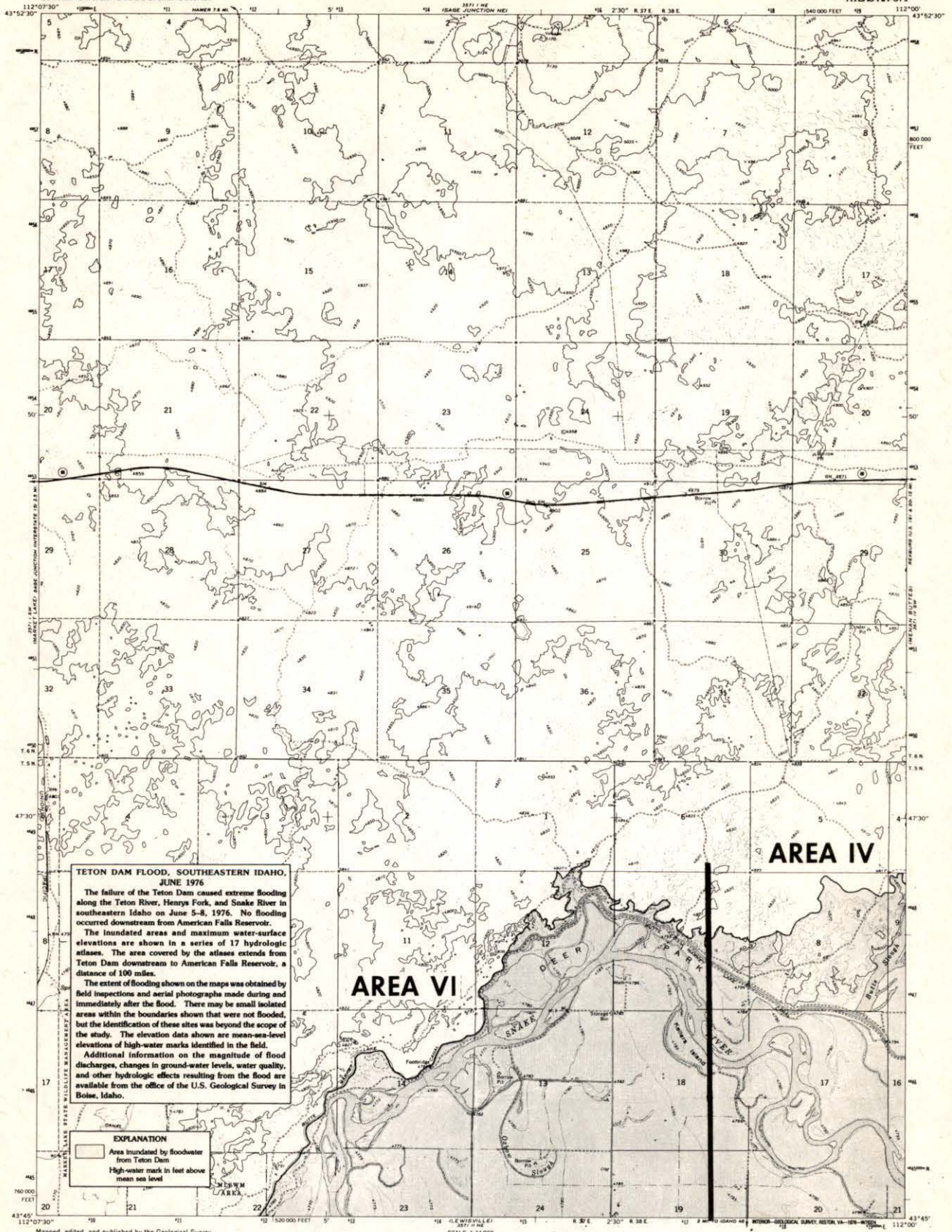
TETON DAM FLOOD OF JUNE 1976, MENAN BUTTES QUADRANGLE, IDAHO

By Cecil A. Thomas, Herman A. Ray, and William A. Harenberg

UNITED STATES GEOLOGICAL SURVEY

ATLAS HA-571



TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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EXPLANATION

Area inundated by floodwater from Teton Dam

High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1959 and planetable surveys 1964

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

Fine red dashed lines indicate selected fence lines

A portion of the southeast quarter of this map lies within a subsidence area

Vertical control based on latest available adjustment

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

UTM GRID AND 1984 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

IDAHO
QUADRANGLE LOCATION

ROAD CLASSIFICATION

Heavy-duty — Light-duty — Unimproved dirt

State Route

For sale by Branch of Distribution, U.S. Geological Survey, 1200 South Eads Street, Arlington, VA 22202 and Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225

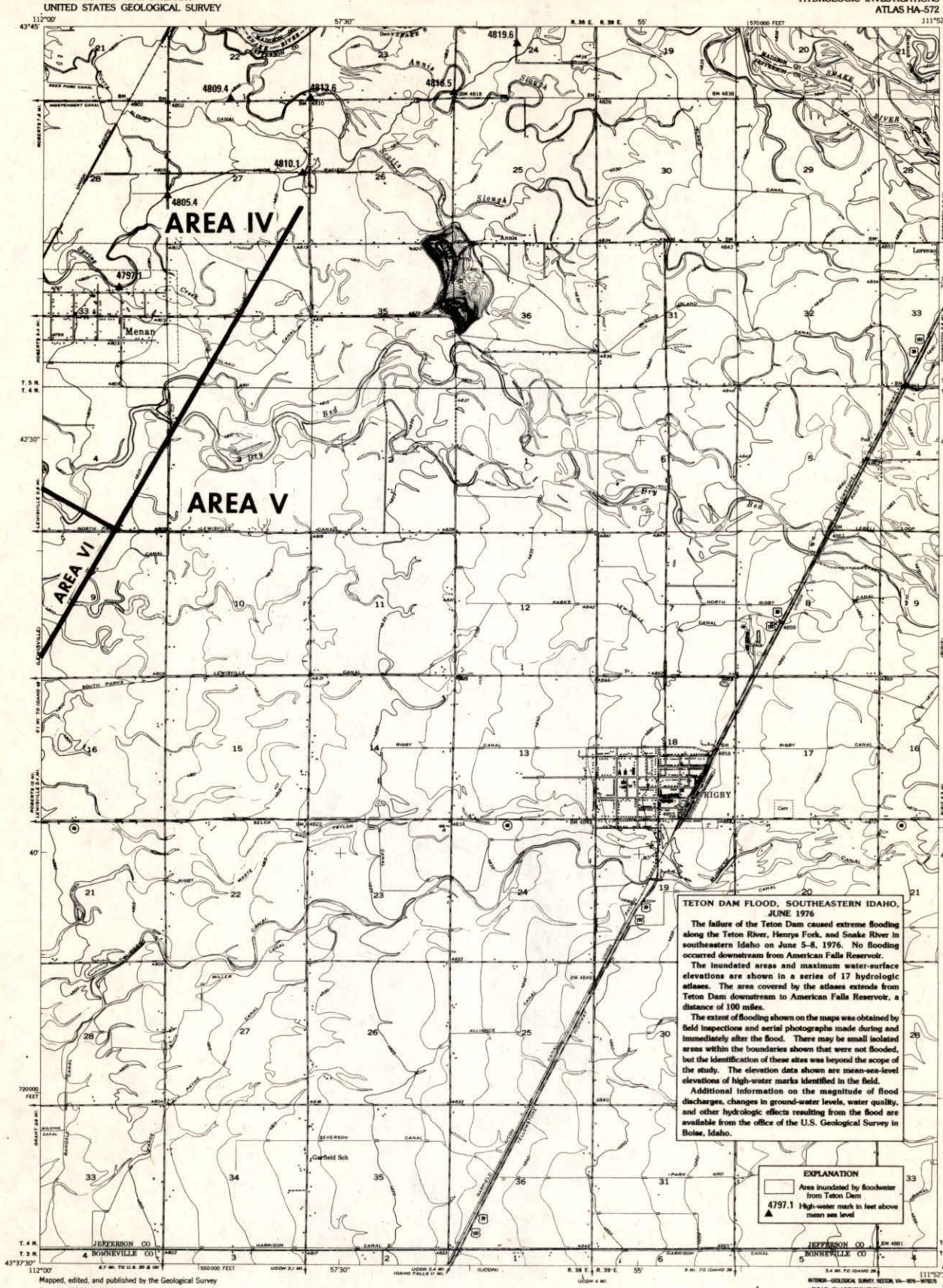
98a

TETON DAM FLOOD OF JUNE 1976, DEER PARKS QUADRANGLE, IDAHO

By Herman A. Ray, C. Michael Bennett, and Andrew W. Records

UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-572



TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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EXPLANATION

Area inundated by floodwater from Teton Dam

4797.1 ▲ High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Culture and drainage by multiplex methods from aerial photographs taken 1946
Topography by plane-table methods 1948

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone

Dashed land lines indicate approximate location

SCALE 1:24 000

CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

APPROXIMATE MEAN DECLINATION, 1948

ROAD CLASSIFICATION

HARD-SURFACE ALL WEATHER ROADS — DRY WEATHER ROADS
Heavy-duty ——— Improved dirt ———
Medium-duty —— Unimproved dirt - - - -
Loose-surface, graded, or narrow hard-surface - - -
U. S. Route ◯ State Route

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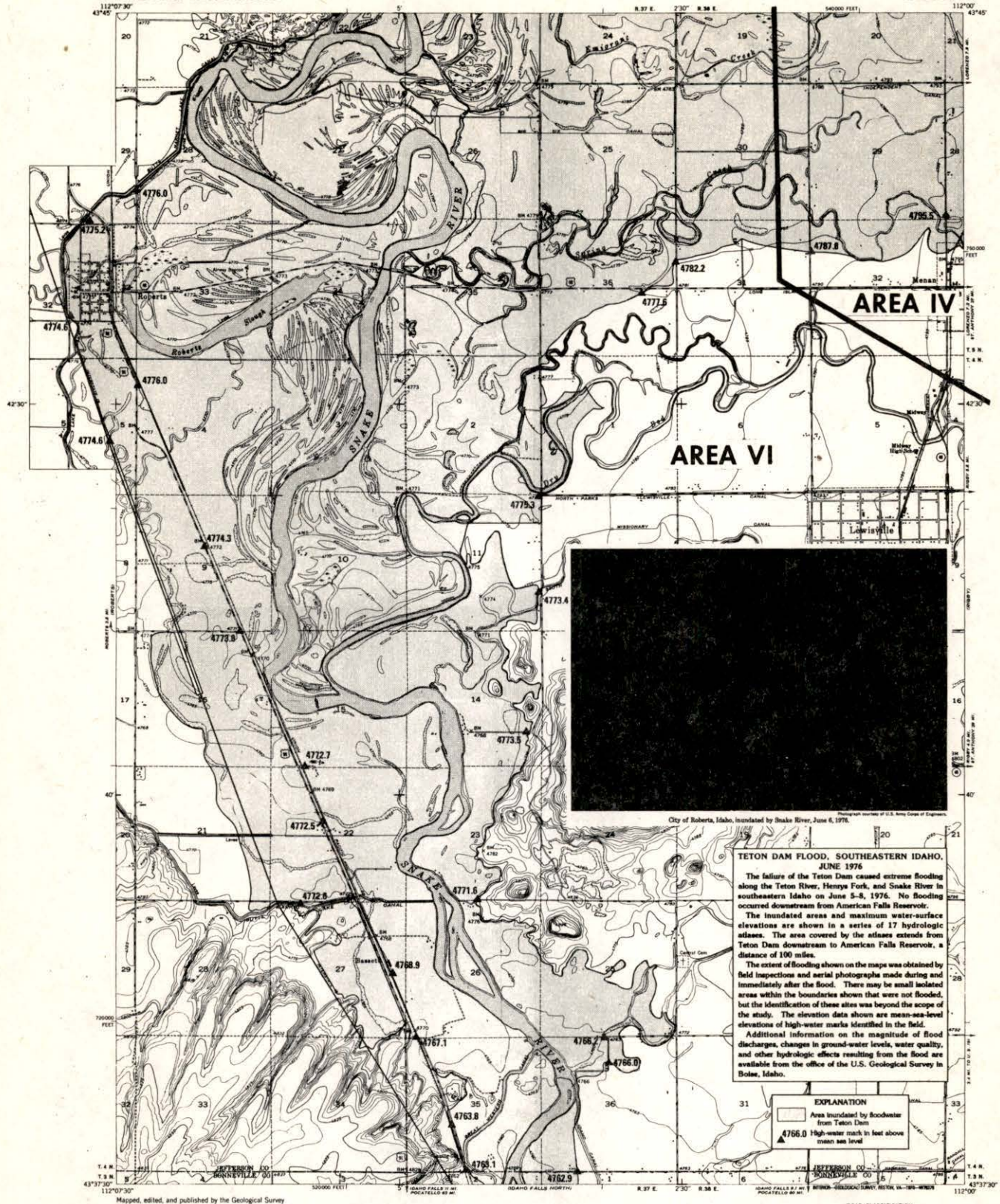
TETON DAM FLOOD OF JUNE 1976, RIGBY QUADRANGLE, IDAHO

By Herman A. Ray and Bruce B. Bigelow

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-573



City of Roberts, Idaho, inundated by Snake River, June 6, 1976.

Photograph courtesy of U.S. Army Corps of Engineers.

TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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EXPLANATION

Area inundated by floodwater from Teton Dam

4766.0 High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS, USC&GS and USED

Culture and drainage by multiplex methods from aerial photographs taken 1946

Topography by plane-table methods 1948

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone

Dashed land lines indicate approximate location

SCALE 1:24 000

CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

APPROXIMATE MEAN DECLINATION, 1948

ROAD CLASSIFICATION

HARD-SURFACE ALL WEATHER ROADS	DRY WEATHER ROADS
Heavy-duty	Improved dirt
Medium-duty	Unimproved dirt
Loose-surface, graded, or narrow hard-surface	
U. S. Route	State Route

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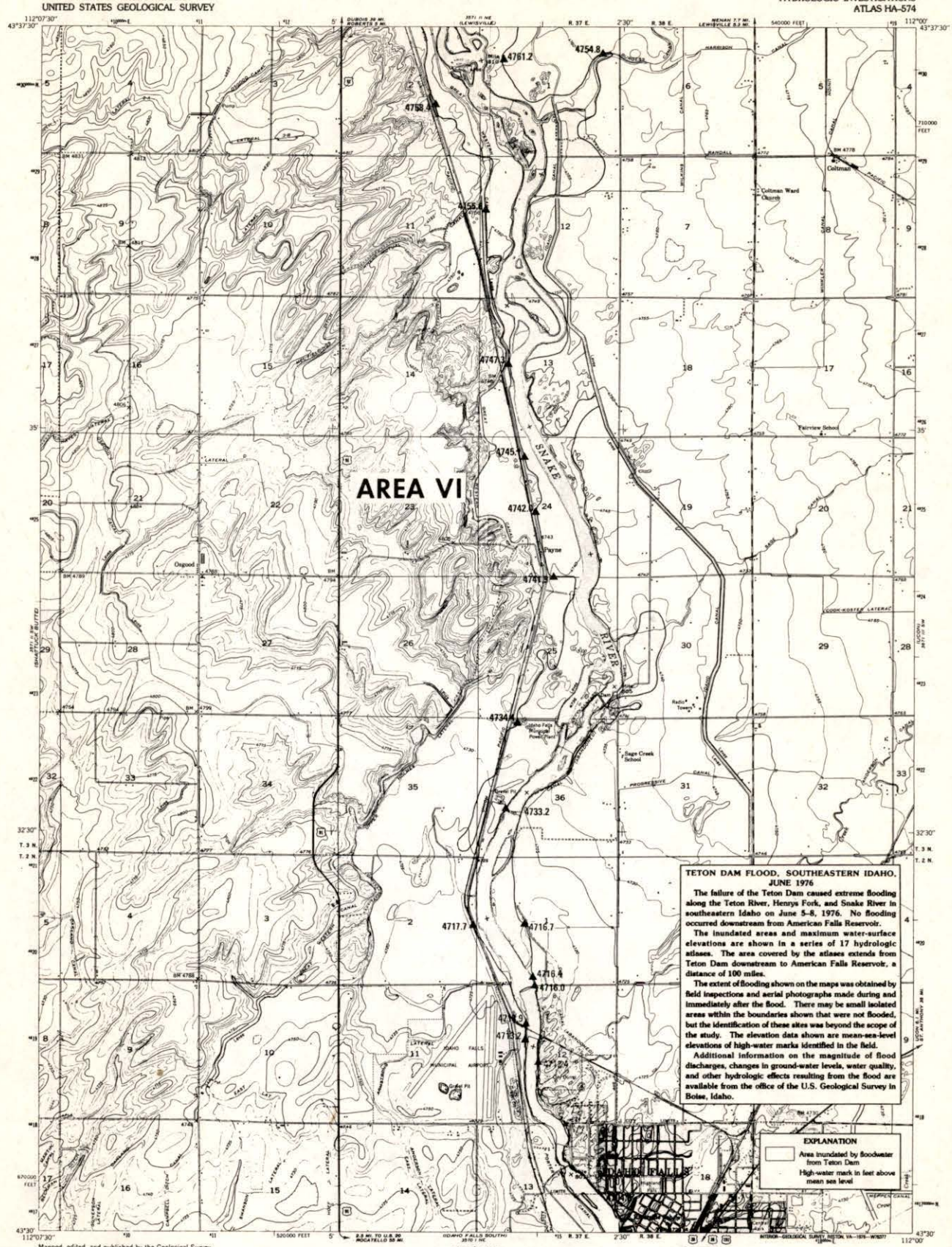
TETON DAM FLOOD OF JUNE 1976, LEWISVILLE QUADRANGLE, IDAHO

By Herman A. Ray and Bruce B. Bigelow

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-574



TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

The failure of the Teton Dam caused extreme flooding along the Teton River, Henrys Fork, and Snake River in southeastern Idaho on June 5-8, 1976. No flooding occurred downstream from American Falls Reservoir.

The inundated areas and maximum water-surface elevations are shown in a series of 17 hydrologic atlases. The area covered by the atlases extends from Teton Dam downstream to American Falls Reservoir, a distance of 100 miles.

The extent of flooding shown on the maps was obtained by field inspections and aerial photographs made during and immediately after the flood. There may be small isolated areas within the boundaries shown that were not flooded, but the identification of these sites was beyond the scope of the study. The elevation data shown are mean-sea-level elevations of high-water marks identified in the field.

Additional information on the magnitude of flood discharges, changes in ground-water levels, water quality, and other hydrologic effects resulting from the flood are available from the office of the U.S. Geological Survey in Boise, Idaho.

EXPLANATION

Area inundated by floodwater from Teton Dam

High-water mark in feet above mean sea level

ROAD CLASSIFICATION

Heavy-duty — Light-duty —

Medium-duty — Unimproved dirt - - - -

U.S. Route

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Culture and drainage by multiplex methods from aerial photographs taken 1946
Topography by plane-table methods 1948

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone

Red tint indicates area in which only landmark buildings are shown

1000-metre Universal Transverse Mercator grid ticks, zone 12, shown in blue

UTM GRID AND 1948 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

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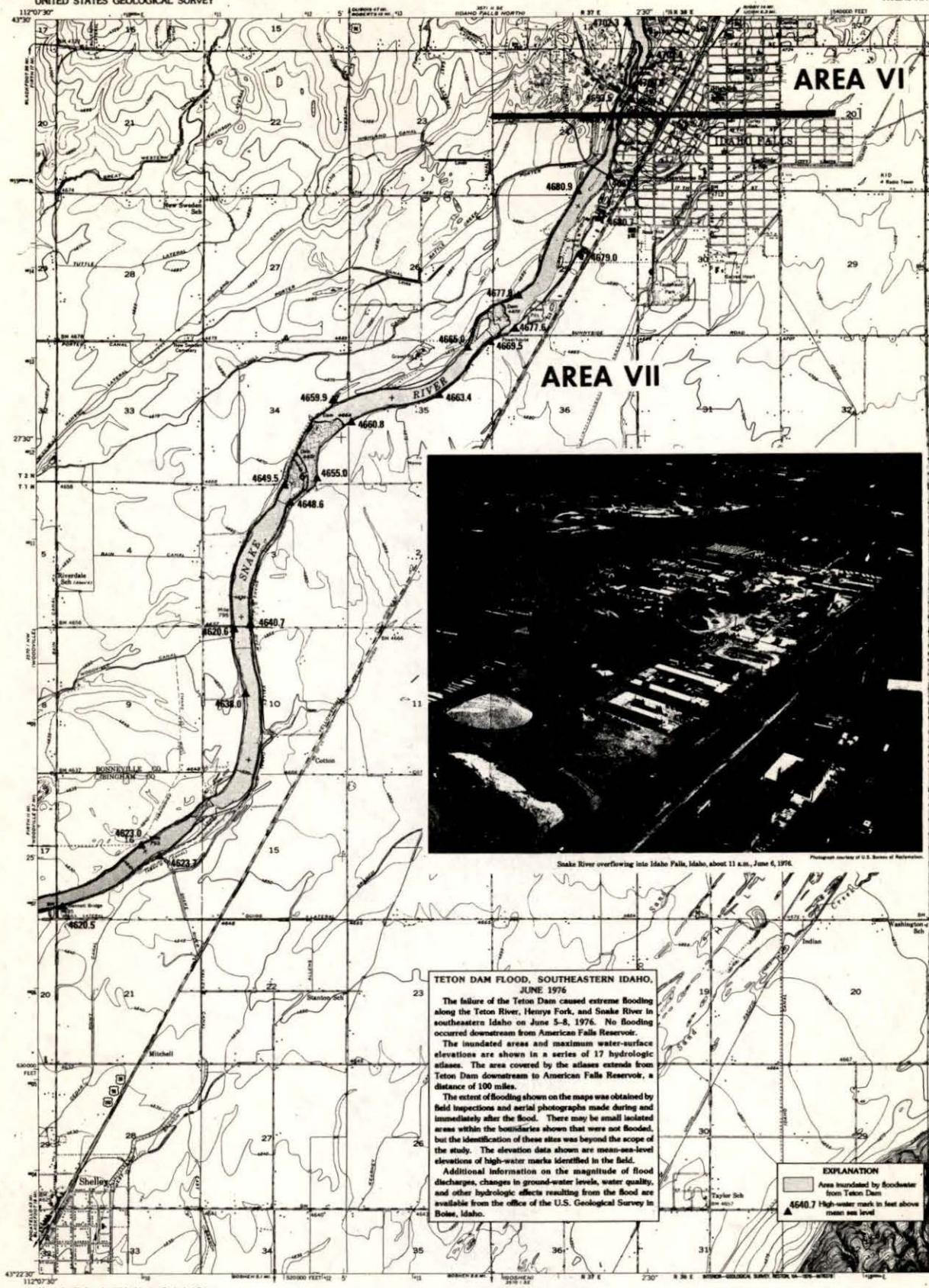
100a

TETON DAM FLOOD OF JUNE 1976, IDAHO FALLS NORTH QUADRANGLE, IDAHO

By Herman A. Ray and Howard F. Matthai

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-575



Snake River overflowing into Idaho Falls, Idaho, about 11 a.m., June 6, 1976.

Photograph courtesy of U.S. Bureau of Reclamation

TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

The failure of the Teton Dam caused extreme flooding along the Teton River, Henrye Fork, and Snake River in southeastern Idaho on June 5–8, 1976. No flooding occurred downstream from American Falls Reservoir.

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The extent of flooding shown on the maps was obtained by field inspections and aerial photographs made during and immediately after the flood. There may be small isolated areas within the boundaries shown that were not flooded, but the identification of these sites was beyond the scope of the study. The elevation data shown are mean-sea-level elevations of high-water marks identified in the field.

Additional information on the magnitude of flood discharges, changes in ground-water levels, water quality, and other hydrologic effects resulting from the flood are available from the office of the U.S. Geological Survey in Boise, Idaho.

EXPLANATION

Area inundated by floodwater from Teton Dam

4640.7 High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Culture and drainage by multiplex methods from aerial photographs taken 1946
Topography by plane-table methods 1948

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone

Red tint indicates area in which only landmark buildings are shown

1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

SCALE 1:24 000

CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION

HARD-SURFACE ALL WEATHER ROADS	DRY WEATHER ROADS
Heavy-duty	Improved dirt
Medium-duty	Unimproved dirt
Loose-surface, graded, or narrow hard-surface	

U.S. Route ○ State Route

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TETON DAM FLOOD OF JUNE 1976, IDAHO FALLS SOUTH QUADRANGLE, IDAHO

By Herman A. Ray and Howard F. Matthai

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-576

TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

The failure of the Teton Dam caused extreme flooding along the Teton River, Henrys Fork, and Snake River in southeastern Idaho on June 5–8, 1976. No flooding occurred downstream from American Falls Reservoir.

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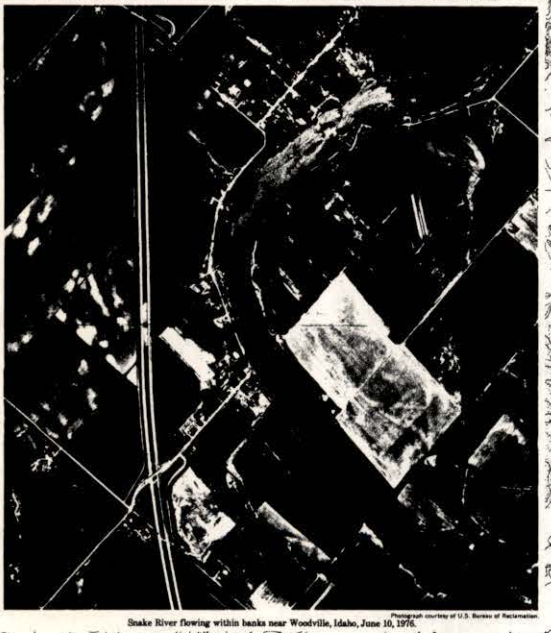

Photograph courtesy of U.S. Bureau of Reclamation.

Snake River flowing within banks near Woodville, Idaho, June 10, 1976.

AREA VII

EXPLANATION

- Area inundated by floodwater from Teton Dam
- 4605.5 ▲ High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS

Topography from aerial photographs by multiplex methods, and by plane-table surveys 1948
Aerial photographs taken 1946

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone

Brown pattern indicates lava flows in which contours are generalized

APPROXIMATE MEAN DECLINATION, 1948

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DASHED LINES REPRESENT HALF-INTERVAL CONTOURS
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION

HARD-SURFACE ALL WEATHER ROADS	DRY WEATHER ROADS
Heavy-duty	Improved dirt
Medium-duty	Unimproved dirt
Loose-surface, graded, or narrow hard-surface	

○ U.S. Route ○ State Route

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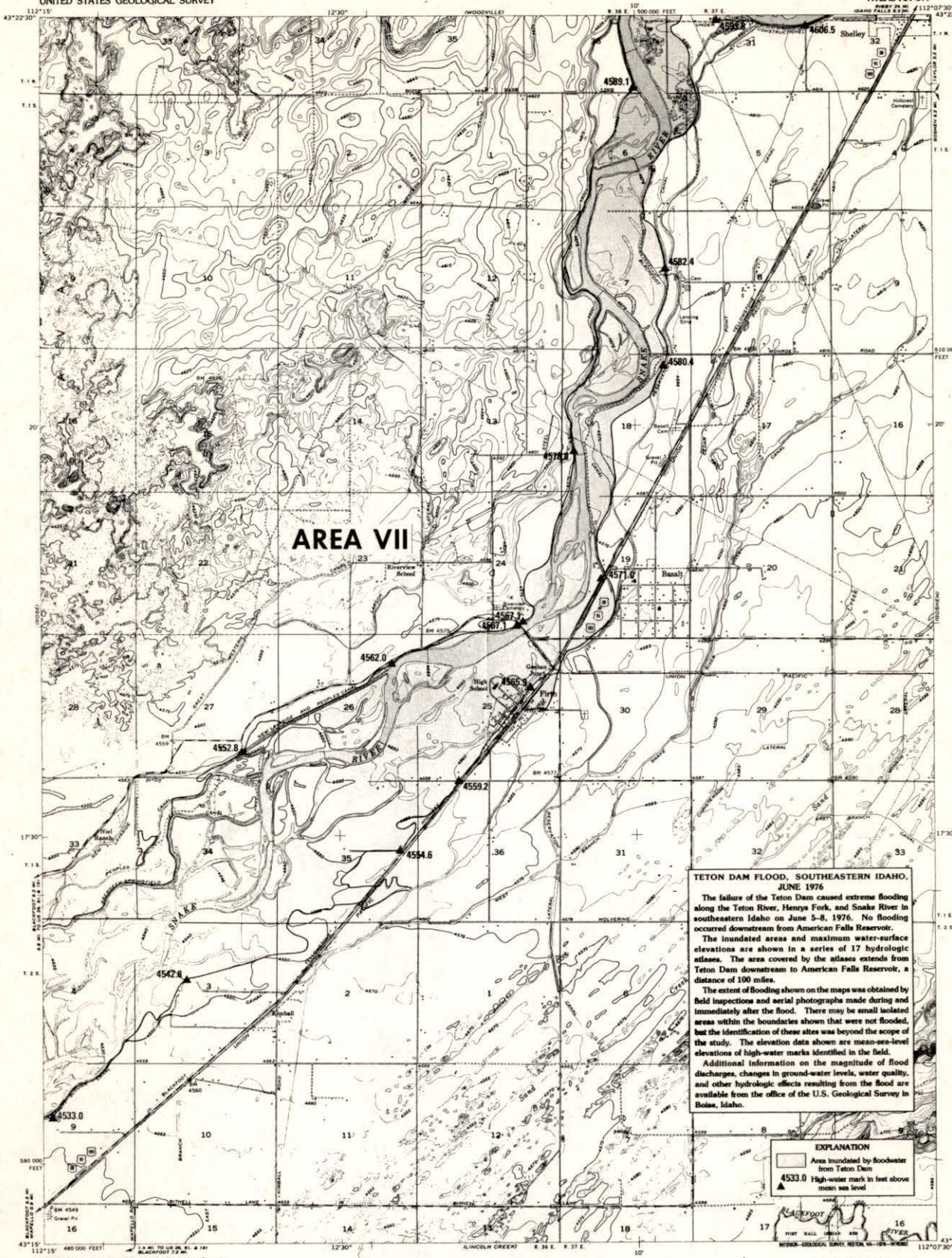
101a

TETON DAM FLOOD OF JUNE 1976, WOODVILLE QUADRANGLE, IDAHO

By Howard F. Matthai and Herman A. Ray

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-577



TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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Additional information on the magnitude of flood discharges, changes in ground-water levels, water quality, and other hydrologic effects resulting from the flood are available from the office of the U.S. Geological Survey in Boise, Idaho.

EXPLANATION

Area inundated by floodwater from Teton Dam

4533.0 ▲ High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by Keish plotter and by planetable surveys 1951 and 1955. Aerial photographs taken 1946

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone

Dashed land lines indicate approximate locations

Brown pattern indicates lava flows in which contours are generalized

SCALE 1:24 000

CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

APPROXIMATE MEAN DECLINATION, 1955

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty ———
Medium-duty ——— Unimproved dirt - - - - - -
U.S. Route ○ State Route

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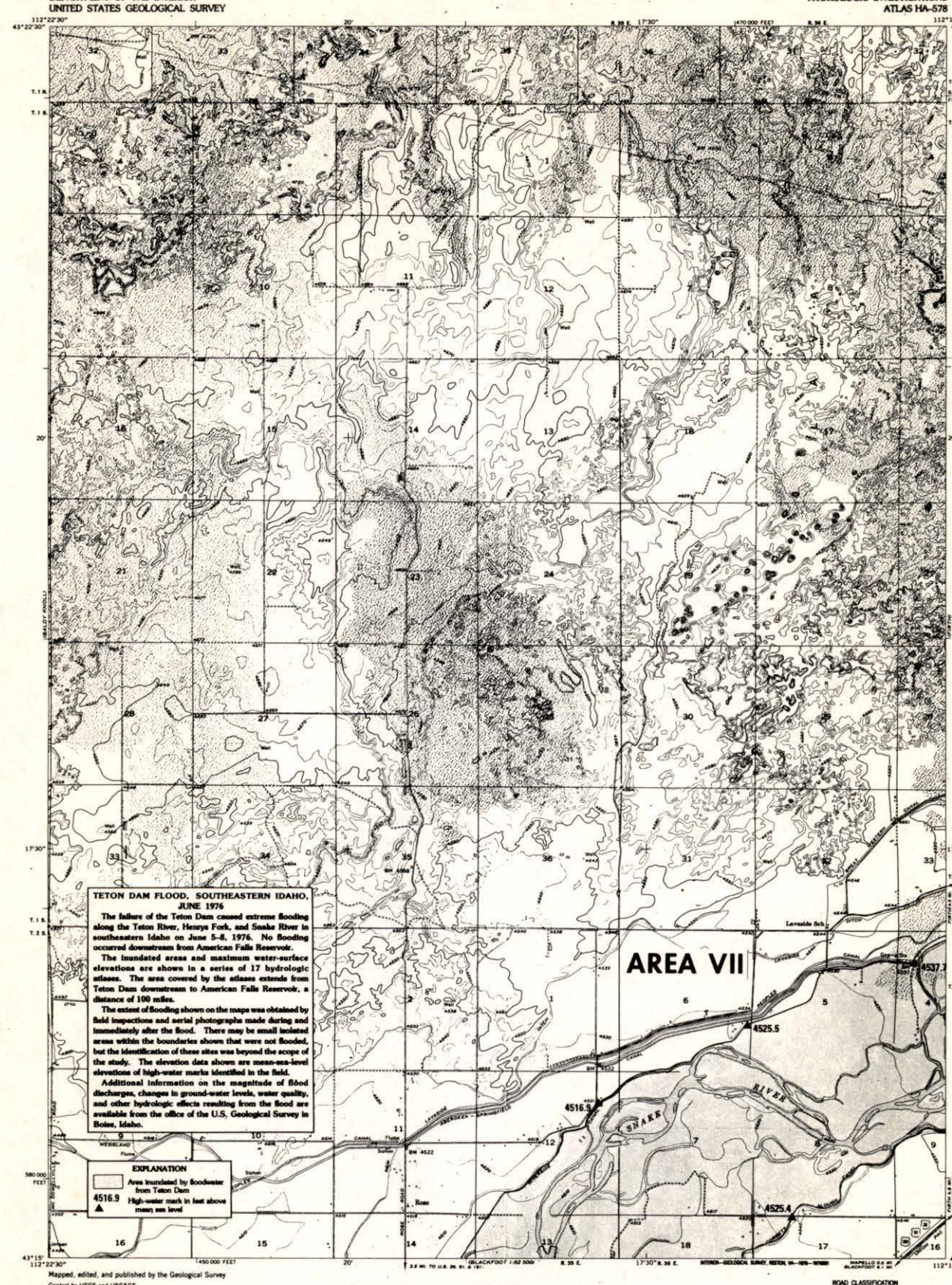
TETON DAM FLOOD OF JUNE 1976, FIRTH QUADRANGLE, IDAHO

By Larry L. Hubbard and John H. Bartells

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-578



TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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Additional information on the magnitude of flood discharges, changes in ground-water levels, water quality, and other hydrologic effects resulting from the flood are available from the office of the U.S. Geological Survey in Boise, Idaho.

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by Kelsh plotter and by planetable surveys 1955. Aerial photographs taken 1950

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone

Dashed land lines indicate approximate location

Brown pattern indicates lava flows in which contours are generalized

Unchecked elevations are shown in brown

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

APPROXIMATE MEAN DECLINATION, 1955

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty ———
Medium-duty ——— Unimproved dirt - - - - - -
U.S. Route State Route

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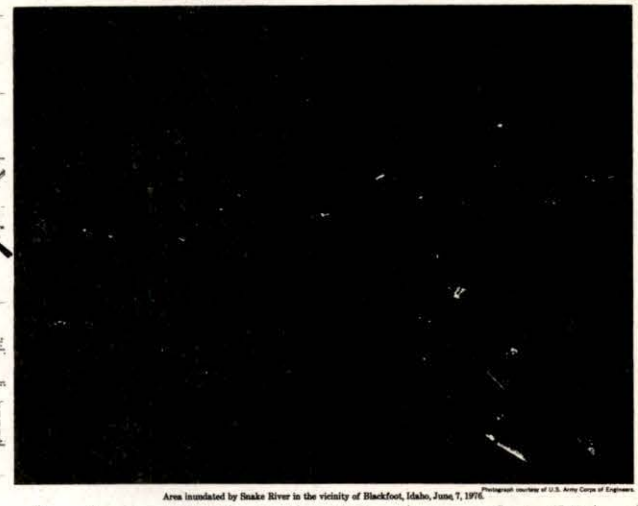
TETON DAM FLOOD OF JUNE 1976, ROSE QUADRANGLE, IDAHO

By John H. Bartells and Larry L. Hubbard

101c

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-579



Area inundated by Snake River in the vicinity of Blackfoot, Idaho, June 7, 1976.

Photograph courtesy of U.S. Army Corps of Engineers.

TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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Additional information on the magnitude of flood discharges, changes in ground-water levels, water quality, and other hydrologic effects resulting from the flood are available from the office of the U.S. Geological Survey in Boise, Idaho.

EXPLANATION

Area inundated by floodwater from Teton Dam

4486.1 ▲ High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1969. Field checked 1971

Projection and 10,000-foot grid ticks: Idaho coordinate system, east zone (transverse Mercator)
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Red tint indicates areas in which only landmark buildings are shown

Fine red dashed lines indicate selected fence lines

UTM GRID AND 1971 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

ROAD CLASSIFICATION

Primary highway, hard surface — Light-duty road, hard or improved surface

Secondary highway, hard surface — Unimproved road

Interstate Route · U.S. Route · State Route

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TETON DAM FLOOD OF JUNE 1976, BLACKFOOT QUADRANGLE, IDAHO

By John H. Bartells and Larry L. Hubbard

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-580

Extensive flooding in Riverside, Idaho, June 7, 1976. Interstate highway 15 at Blackfoot, Idaho, in foreground.

Photograph courtesy of U.S. Army Corps of Engineers

AREA VIII

TETON DAM FLOOD, SOUTHEASTERN IDAHO, JUNE 1976

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Additional information on the magnitude of flood discharges, changes in ground-water levels, water quality, and other hydrologic effects resulting from the flood are available from the office of the U.S. Geological Survey in Boise, Idaho.

EXPLANATION

Area inundated by floodwater from Teton Dam

4469.6 ▲ High-water mark in feet above mean sea level

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1969. Field checked 1971

Projection and 10,000-foot grid ticks: Idaho coordinate system, east zone (transverse Mercator)
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum

Fine red dashed lines indicate selected fence lines

SCALE 1:24 000

CONTOUR INTERVAL 5 FEET
DATUM IS MEAN SEA LEVEL

UTM GRID AND 1971 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

IDAHO
QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, hard surface — Light-duty road, hard or improved surface

Secondary highway, hard surface — Unimproved road

Interstate Route — U. S. Route — State Route

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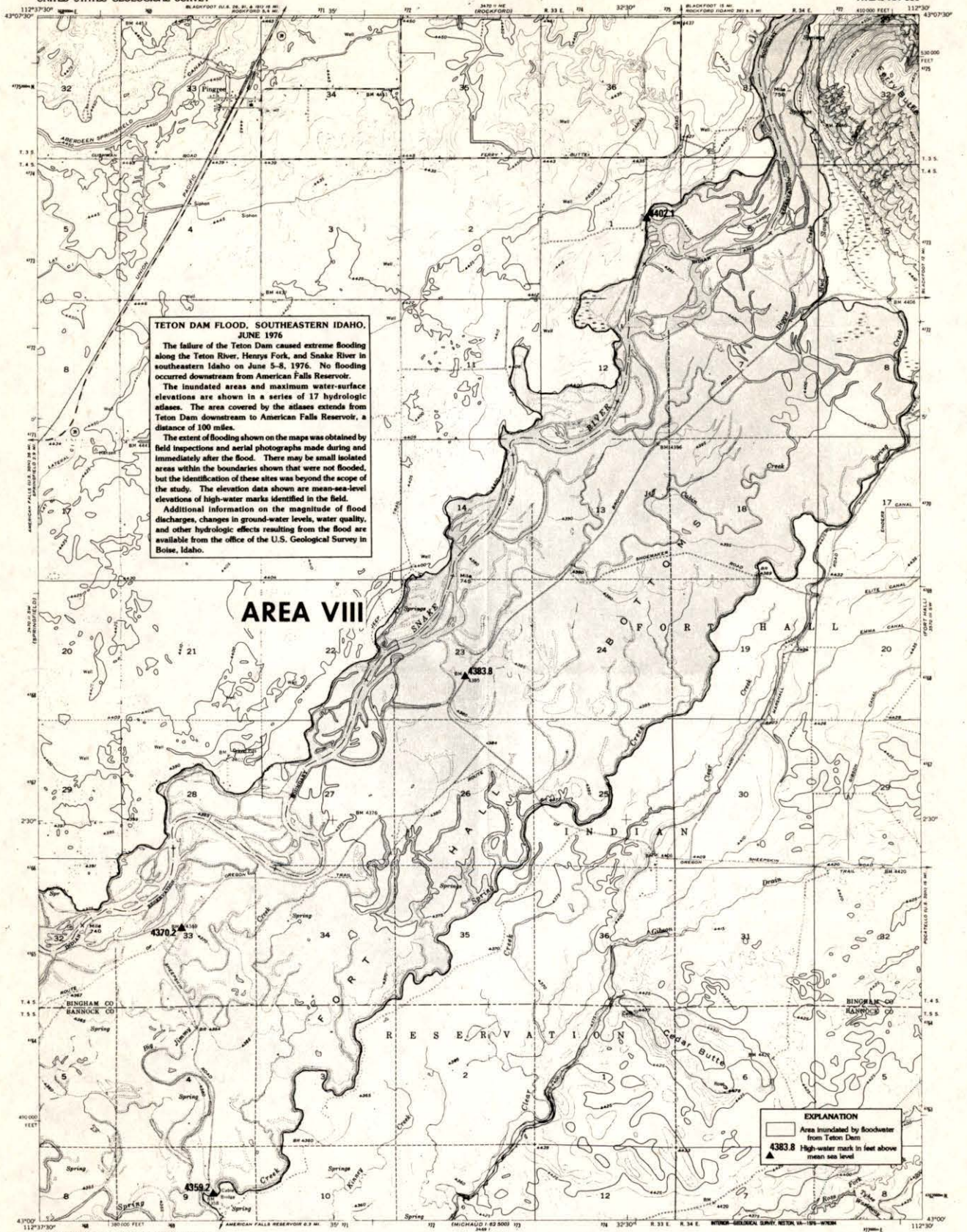
TETON DAM FLOOD OF JUNE 1976, MORELAND QUADRANGLE, IDAHO

By Larry L. Hubbard and John H. Bartells

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA-581



Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Culture and drainage compiled from aerial photographs taken 1946. Topography from planetable surveys by U. S. Indian Service 1923-25 and U. S. Geological Survey 1955

Polyconic projection. 1927 North American datum
10,000-foot grid based on Idaho coordinate system, east zone

Dashed land lines indicate approximate locations

1000-metre Universal Transverse Mercator grid ticks, zone 12, shown in blue

SCALE 1:24 000

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

UTM GRID AND 1955 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

ROAD CLASSIFICATION

Heavy-duty ——— Light-duty - - - -
Medium-duty ——— Unimproved dirt - - - - -
U.S. Route ○ State Route

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TETON DAM FLOOD OF JUNE 1976, PINGREE QUADRANGLE, IDAHO

By Larry L. Hubbard and John H. Bartells

SUPPLEMENTAL APPENDICES

APPENDIX A

A plan for mitigating fish and wildlife losses, Teton Basin Project, Lower Teton Division, Idaho.

A Plan for Mitigating Fish and Wildlife Losses
Teton Basin Project, Lower Teton Division
Idaho

Teton Dam, now under construction by the Bureau of Reclamation in Teton Canyon, will have a number of adverse effects on fish and wildlife. The major losses will be 17 miles of trout stream and the adjacent canyon slopes that provide vital winter range for big game. The brushy, steep-walled canyon is in marked contrast to the surrounding uplands, which are open grainfields and livestock range.

The purpose of this plan is not to describe at length the impact of the impoundment on fish and wildlife but to document possible means for lessening this impact. It is impossible to replace in kind the environmental features now provided by the reach of stream to be inundated by the reservoir. However, a number of measures can be included in the project that would provide a degree of counterbalance to the losses that will occur. Although full compensation of the losses cannot be achieved, institution of these measures will create the best situation possible for the fish and wildlife resources under the circumstances.

In essence, the measures consist of the following:

Fish hatchery facilities
Public streamside access
Minimum flows in Teton River
Fish screens on pumping plant
Acquisition of lands for wildlife at three locations
Development and management of these lands

These proposals are discussed in greater detail in the following text, and specific recommendations with estimated costs are listed at the close of this report.

Fish

It is not likely that Teton Reservoir will support a good trout fishery, but there will be a public demand for recreational use of the impoundment and adjacent land for fishing, boating, and other purposes. An effort should be made to meet this demand by providing adequate public access around the margin of the reservoir and by a fish stocking program.

Plans have been made by the Bureau of Reclamation to establish access areas on the reservoir shoreline where feasible. If no State of local agency can be found to manage and maintain the reservoir access areas, then the Bureau of Reclamation should assume this responsibility.

With project funding, the Idaho Fish and Game Department proposes to stock 300,000 young cutthroats annually in the reservoir for a 2-year period and, starting at the same time, stock 500,000 kokanee fingerlings annually

for eight years. If stocked cutthroats fail to thrive, then the kokanee may prove more successful. Also, yearling cutthroats would be stocked in the Teton River downstream from the dam at the rate of 100,000 annually. If these cutthroats fail to thrive, then rainbow trout would be substituted. Two additional raceways should be constructed, probably at the State's American Falls Hatchery, for rearing the trout needed for the downstream stocking.

Public access to at least five miles of stream in the general vicinity of the reservoir is needed to help mitigate the loss of 17 miles of stream. A particularly desirable reach for access trails would be the first few miles of the Teton River downstream from Lower Teton Dam. A camping and day-use recreational area should be developed adjacent to the tailrace immediately below the dam as part of the overall reservoir recreational plan. This area could serve as a starting point for people wishing to fish downstream on foot or by boat. Adequate parking space, trash barrels, fence stiles, and the like should be provided as deemed necessary at all stream access areas acquired. Access easements or leases for this purpose might serve just as well as fee title acquisition, but also might be just as costly. Additional studies will be necessary to determine where access is most needed.

A minimum flow of 300 cfs should be sustained at all times in the Teton River downstream from the dam to preserve the aquatic habitat and related fishery. Also, the pumping plant in the combined power and pump plant structure at the dam should be screened to prevent losses of fish that likely will concentrate in the stream channel close to the dam.

Wildlife

The Teton River drains an area extending from the high wooded plateau south of Yellowstone Park to the western slopes of the rugged Teton Range and the north slopes of the Big Hole Mountains. This is summer range for mule deer, elk, and moose. In the late fall, a number of these animals follow tributaries downstream until they converge on Teton Canyon. Here, below the barren upland flats, they find both foods and shelter from the fierce winter storms that sweep this region. There is no alternative sanctuary. When Lower Teton Dam is completed, a substantial portion of the canyon, with its trees, brush, and protecting topography, will be inundated and no longer available to wintering big game.

Normally, an effort is made to accomplish loss mitigation measures on-site or very close to the project site, but this is not possible here. A modest amount of habitat management for wildlife on land around Lower Teton Reservoir is included in this plan, but due to the limited area suitable for this purpose, additional land should be acquired for wildlife at other site.

About 960 acres of peripheral land have been added to the Lower Teton Reservoir right-of-way to provide space for habitat management and development. About 35 miles of fence will be built around the reservoir

lands to control livestock use. Such control will help to reduce erosion and environmental deterioration. However, the deer and elk which winter here will not be sustained by these limited efforts. Even with habitat development the existing herds will be reduced by 50% or 500 animals.

Therefore, about 15,000 acres of traditional big-game winter range have been selected on Tex Creek, in the Willow Creek drainage about 30 miles south of Lower Teton Reservoir. Although in a different drainage and used by different big game animals, this tract has a much greater potential for range improvement and increase in carrying capacity than do any lands in the project vicinity. Management of the Tex Creek tract would include reduction of livestock grazing and conversion of cultivated land to grass and brush suitable for big-game winter range. Elk would benefit most from the proposed habitat improvement, but carrying capacity for mule deer would increase also. Nearly half the tract consists of State and Federal land.

A third area believed necessary to mitigate wildlife losses is a 400-acre tract of Cartier Slough on Henrys Fork about 20 miles southwest of Lower Teton Dam. A moderate amount of development to increase the acreage of water area is proposed. Preservation and management of this wetland tract would primarily benefit waterfowl and fur animals. At the present time the only open water in the area is the Teton River which is used quite extensively by ducks and geese.

General

If this fish and wildlife plan for the Teton Basin Project materializes, it would mesh well with the plan for Ririe Reservoir, which is now under construction by the Corps of Engineers but which will be administered by the Bureau of Reclamation. The 400-acre tract at Cartier Slough would be adjacent to the 560-acre area already established there in connection with the Ririe project. Similarly, the Tex Creek big-game range would be continguous to the established big-game range at Ririe Reservoir (see location map).

Recreational access areas on the shorelines of the two reservoir, the stream access sites, and the fish-stocking programs would also be interrelated. It would be advantageous for all agencies involved (at least the Bureau of Reclamation, the Bureau of Sport Fisheries and Wildlife, and the Idaho Fish and Game Department) to meet annually to inspect the various sites and discuss management plans and coordination of efforts. It would be especially important to insure that the recreational development and fish and wildlife management programs do not conflict.

It is recommended that:

1. To mitigate fishery losses:

   a. Two hatchery raceways be installed at an existing hatchery to rear trout for stocking downstream from Teton Reservoir. The estimated construction cost is $23,000, and the annual operation, maintenance, and replacement costs total $8,500. The latter includes annual costs for all stocking operations related to the Teton Basin Project. Construction and operation of these facilities will be carried out by the Idaho Fish and Game Department with funds provided by the Bureau of Reclamation.

   b. Public fishing access be acquired on selected reaches of trout stream in the vicinity of the Teton Basin Project. Estimated capital cost for fee acquisition is $63,000; however, an appropriate lease would be acceptable. Access areas are to be provided by the Bureau of Reclamation or the Idaho Fish and Game Department. Annual O&M is estimated to be $1,000 annually to maintain each access site.

   c. A minimum flow of 300 cfs be sustained in the Teton River downstream from Lower Teton Dam.

   d. Screens be installed on the intake to the Pumping Plant. The estimated capital cost is $25,000, and the annual operation, maintenance, and replacement costs total $1,000. The Bureau of Reclamation is to install and maintain the screens.

2. To mitigate wildlife losses:

   a. About 960 acres be acquired by the Bureau of Reclamation at designated points around the periphery of Lower Teton Reservoir and be developed and managed by the Idaho Fish and Game Department as big-game winter range. The acquisition cost is estimated at $96,000.

   b. Peripheral lands around Lower Teton Reservoir be fenced by the Bureau of Reclamation. The estimated cost is $35,000 for construction of 35 miles of fence and $3,500 for annual maintenance.

   c. About 15,140 acres be acquired by the Bureau of Reclamation for big-game winter range on Tex Creek. The estimated acquisition cost is $811,000 for 8,563 acres of private land and 2,400 acres of State land. The remaining 4,241 acres are Public Domain lands under the jurisdiction of the Bureau of Land Management. The Bureau of Reclamation would also provide an additional $757,000 for development work on the land, $40,000 for construction of headquarters buildings, and $21,500 annually for operation, maintenance, and replacement (the latter includes all annual operation costs for

big-game measures related to the Teton Basin Project). The Idaho Fish and Game Department would perform the development work and handle the annual O&M with funds provided by the Bureau of Reclamation.

d. About 400 acres of marshland at Cartier Slough be acquired. The estimated cost is $80,000 for acquisition, $15,000 for development, and $1,500 annually for OM&R. The Bureau of Reclamation would acquire the land and reimburse the Idaho Fish and Game Department for development and annual O&M costs.

3. To insure coordination of the interrelated fish, wildlife, and recreational programs at both the Teton Basin Project and Ririe Dam and Reservoir, annual meetings be held among representatives of the Bureau of Reclamation, Bureau of Sport Fisheries and Wildlife, the Idaho Fish and Game Department, and any other agencies that might become involved in the administration of these programs, to review management plans together.

4. All lands acquired by the Federal government for fish and wildlife loss mitigation purposes be administered by the Idaho Fish and Game Department in accordance with a General Plan as provided for in Section 3 of the Fish and Wildlife Coordination Act and developed and managed under a subsequent cooperative agreement between Idaho Fish and Game and the Bureau of Reclamation.

5. All capital, operation, and maintenance costs of mitigation measures, recommended as project costs, be treated in the same manner as other joint costs and allocated among the beneficial purposes of the project.

SUMMARY OF FISH AND WILDLIFE MITIGATION COSTS
TETON PROJECT

	Construction
Fishery	
Screens on intake to Pumping Plant	$ 25,000
Two hatchery raceways	23,000
Fisherman access to river (above and below)	63,000
Total fishery	$ 111,000
Big Game and Upland Game	
Acquisition of 960 acres for big game	96,000
Establishment of browse areas	757,000
Fencing to keep cattle out	35,000
Acquisition of 15,141 acres for Tex Creek range	811,000
Tex Creek headquarters and management	40,000
Total big game and upland game	$1,739,000
Waterfowl	
Acquisition of 400 acres at Cartier Slough	80,000
Development of Cartier Slough and management	15,000
Total waterfowl	$ 95,000
TOTAL FISH AND WILDLIFE MITIGATION Construction	$1,945,000

Estimated costs based on July 1972 price levels

APPENDIX B

Stabilization of Soils in Teton Canyon

1. Mr. Robert Schuster and the members of the landslide team (USGS, Denver) feel that the areas of sloughing in Teton Canyon have stabilized. At the time of the dam failure, the vegetation had been removed to the high water line and the soils had been saturated by water with the filling of the pool, creating optimum conditions for sloughing. Mr. Schuster believes that the soil movement that took place under those optimum conditions is over.

   The soils will continue to be stable until the conditions at the time of sloughing are exceeded, which is very unlikely. Surface erosion will probably be the worst problem and Mr. Schuster feels this can be taken care of with proper vegetation. All aspects of soil movement should be monitored for the first year. Major problem areas should be identified and efforts made to stabilize them.

2. Mr. Gwin from the Idaho Department of Highways was contacted to gather information on how road cuts are stabilized. He said that proper vegetation is the best and most used technique. If this fails, mechanical stabilizers such as a sheeps foot roller, vibrating roller, or a grid roller could be used to stabilize the top six inches of soil. He knows of no methods to stop sloughing or landslides. Mr. Gwin also suggested that the slides should be looked at during high water this spring.

3. Mr. Jerry Peterson, of Northern Testing Laboratory feels that there may be some sloughing and surface erosion during high run-off. His firm would be very willing to write a contract proposal for the monitoring and stabilization of the soil in the Teton Canyon. Northern Testing Laboratory is at present doing testing on the dam structure for the Blue Ribbon Study Team.

4. Mr. Robert Jones, Consulting Engineer, stated he had experience in the Teton Canyon and would be willing to submit a contract proposal for stabilizing the surface erosion and sloughing taking place in the canyon.

APPENDIX C

Stream Improvement Structures

The objective to restore the fishery in the Teton River means that the stream must provide the most favorable living conditions possible for trout. In order for a stream to provide favorable living conditions, all aspects of the fishes life must be taken into consideration. Survival, growth, and reproduction require fertile water, sufficiency of living space, favorable water temperatures, gravel streambed for spawning and shelter against predators. Natural recovery will provide these requirements in many areas but some areas may need additional restoration in the form of stream improvement structures, vegetation, debris removal, etc.

Wisconsin has had much success with stream improvement structures in their rehabilitation of trout streams. On the other hand, several small California programs to install instream devices have had discouraging results. The programs in California were in high gradient Pacific slope streams, while Wisconsin's projects were on low gradient high production streams. The Teton River, after leaving the canyon, is a low gradient stream that would lend itself well to the successful use of stream channel improvement structures if done with proper planning and construction.

In the upper reaches of Teton Canyon, large boulders could be used with the construction of the productive flat riffles to provide fish cover and hold spawning gravels in place. In Canyon Creek, gabions and gabion weirs could be used to stabilize the bank and hold back bed load.

1. Gabions: These are made up with a welded wire basket filled with rock and are placed in the stream channel to reduce water velocity and stabilize bedload movement (Figures 1 and 2).

2. Large Boulders: One to two cubic yard boulders should be used to withstand normal floods. The boulders provide resting locations and velocity breaks in the areas the channel has been disturbed (Figure 3).

3. Gabion Weirs: Used to stabilize stream beds, create pools and hold spawning gravel (Figure 4).

4. Hewett Ramp: These ramps are used to decrease water velocity and create pool and cover areas for fish (Figure 5).

5. Bank Covers: Artificial bank covers are used to create cover and shade in areas that have been riprapped or lack vegetation (Figure 6).

6. Wing Deflectors: When the stream is forced to meander in a limited channel by wing deflectors, fish resting areas, and cover are created.

7. Bank Cover: Construction details.

Estimated cost of stream improvement structures.

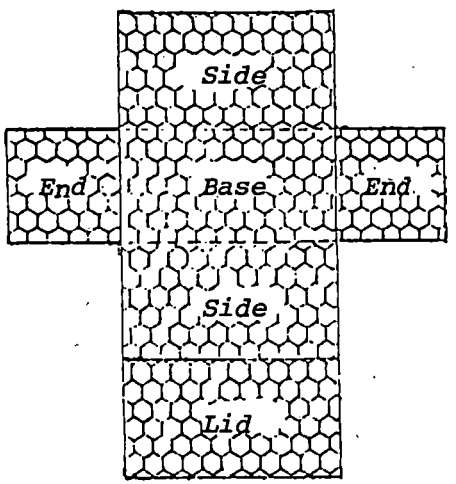
Gabions	$2,500.00
Gabion weirs	2,500.00
Wing Deflectors	550.00
Hewett ramps	700.00
Bank covers	750.00

Figures 1, 2, 3, and 4 taken from Bureau of Land Management Manual 6760, Stream Preservation and Improvement.

Figures 5 and 6 taken from An Evaluation of Stream Channel Relocation on the South Fork of the Coeur d'Alene River, by James E. Winner, Idaho Department of Water Resource.

Gabion Illustration - Fisheries

Gabions are shipped flat



The wire frame is assembled into a basket, placed in desired position, filled with rock and top secured with wire.

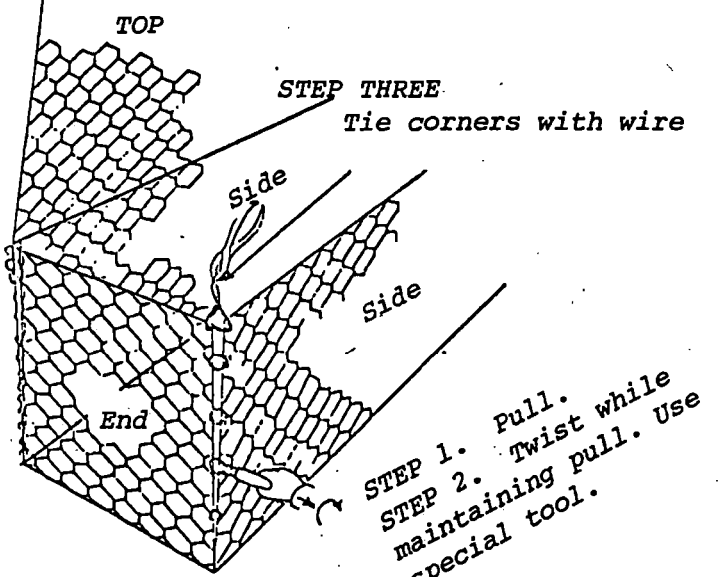
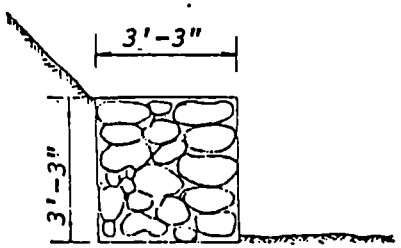
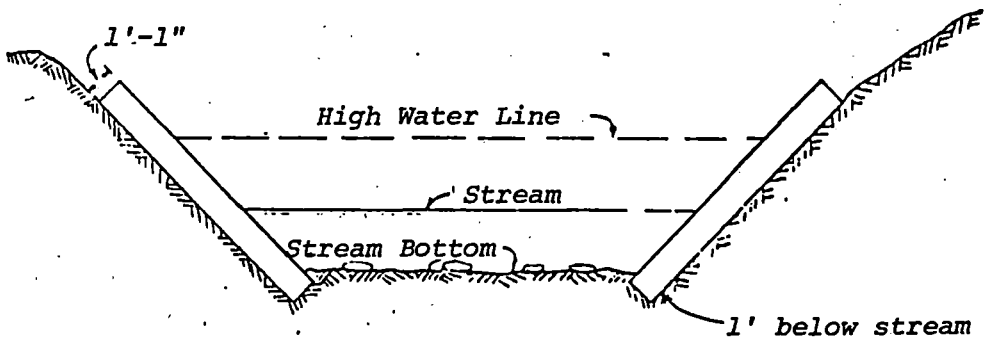


Figure 1

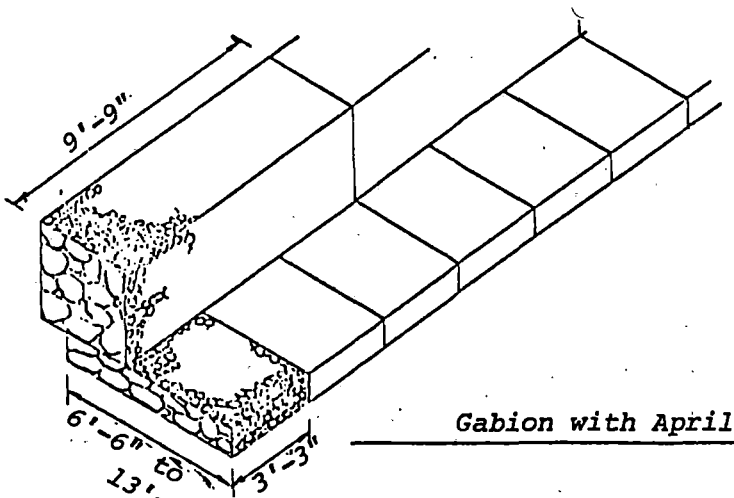
Use of Gabions in Stream Bank Control

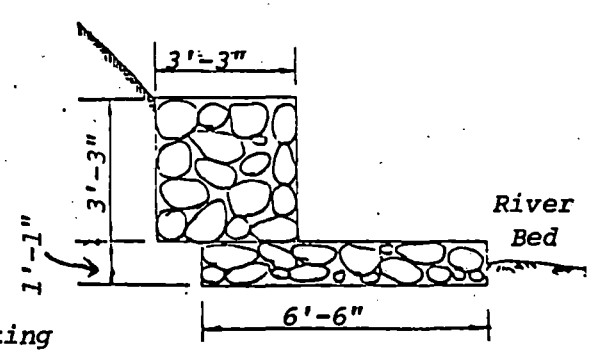


Single Gabion Rock Fill Where Little Undercutting is Expected



Gabion Mats





Gabion with April to Prevent Undercutting

Diagramatic Sketch of Boulder Placement

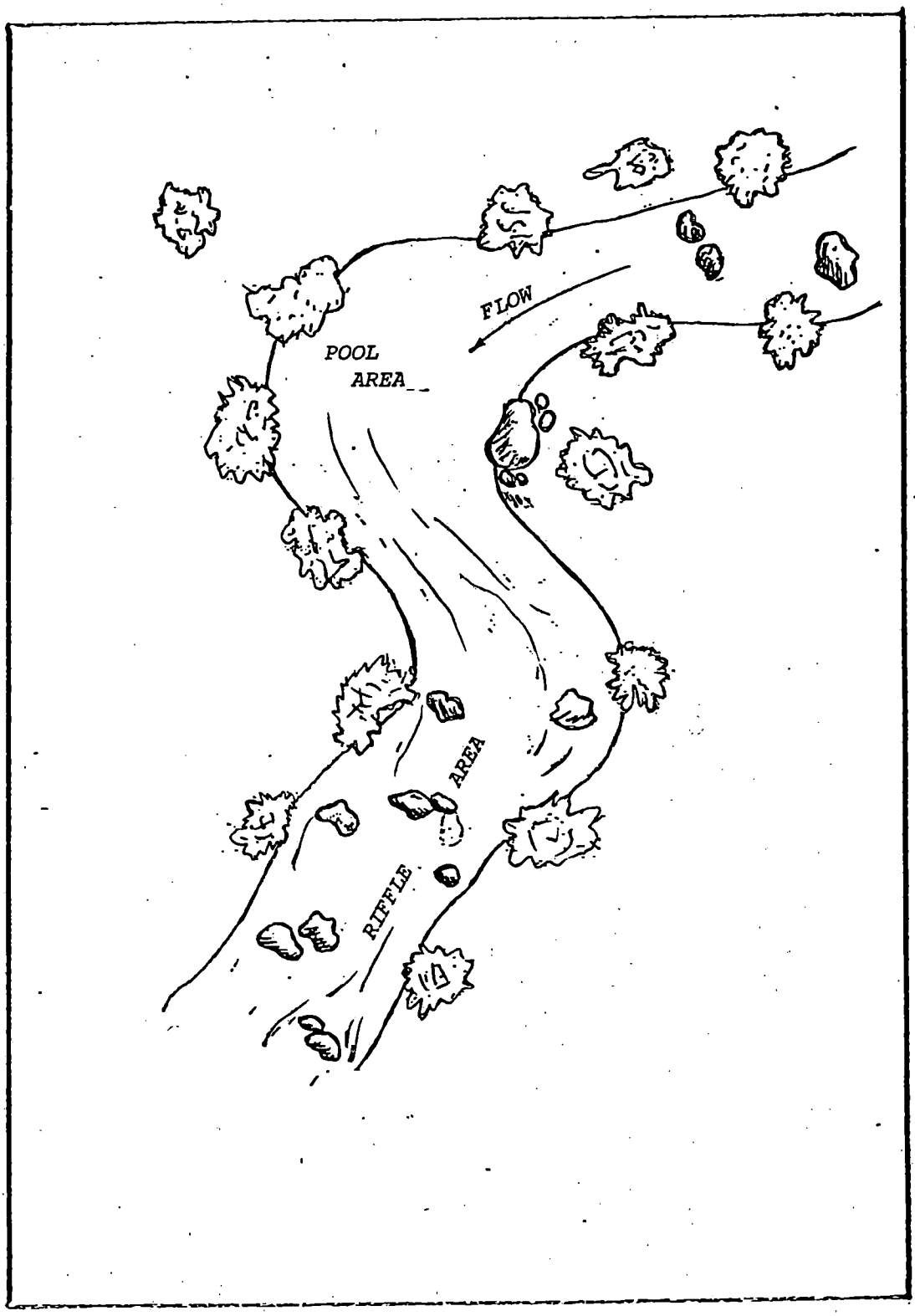


Figure 3

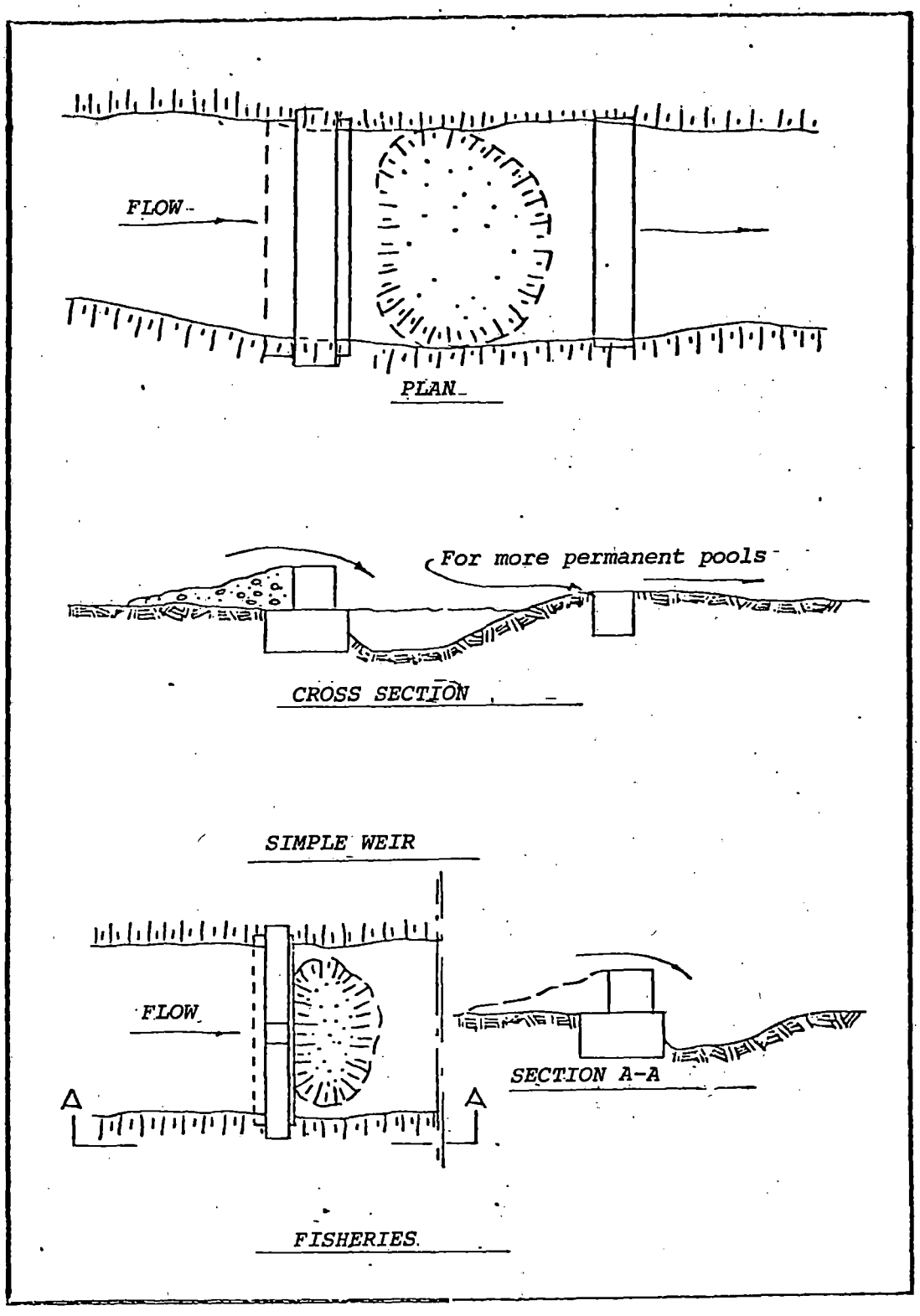
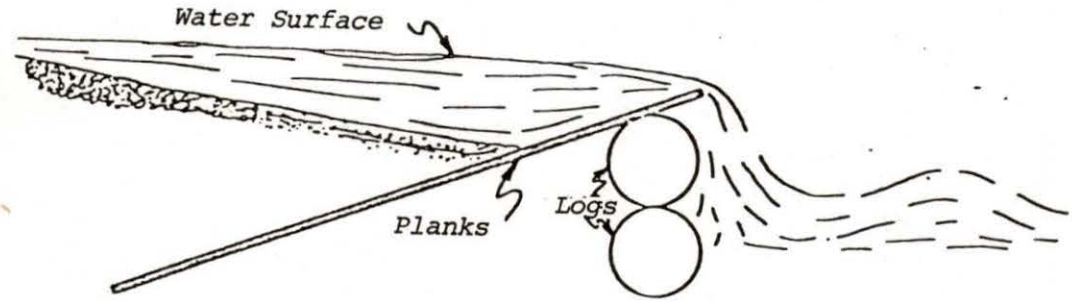

FLOW
PLAN
For more permanent pools
CROSS SECTION
SIMPLE WEIR
FLOW
A
A
SECTION A-A
FISHERIES

Figure 4

CONSTRUCTION DETAIL OF HEWETT RAMPS



SIDE VIEW

DOWNSTREAM VIEW

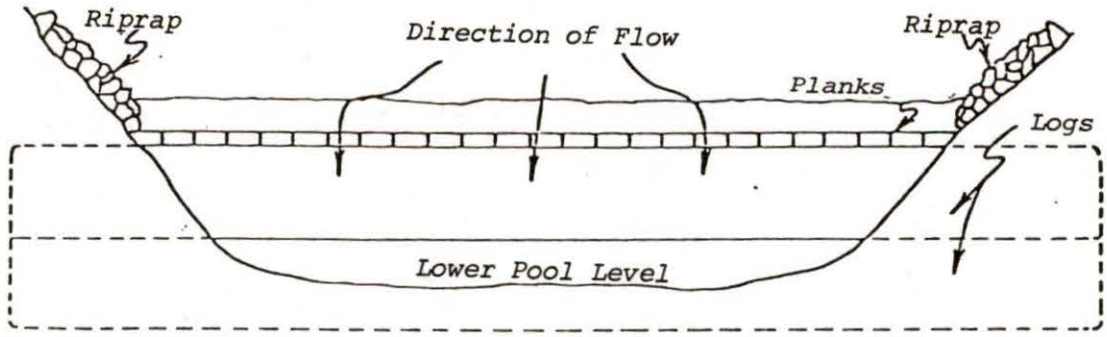
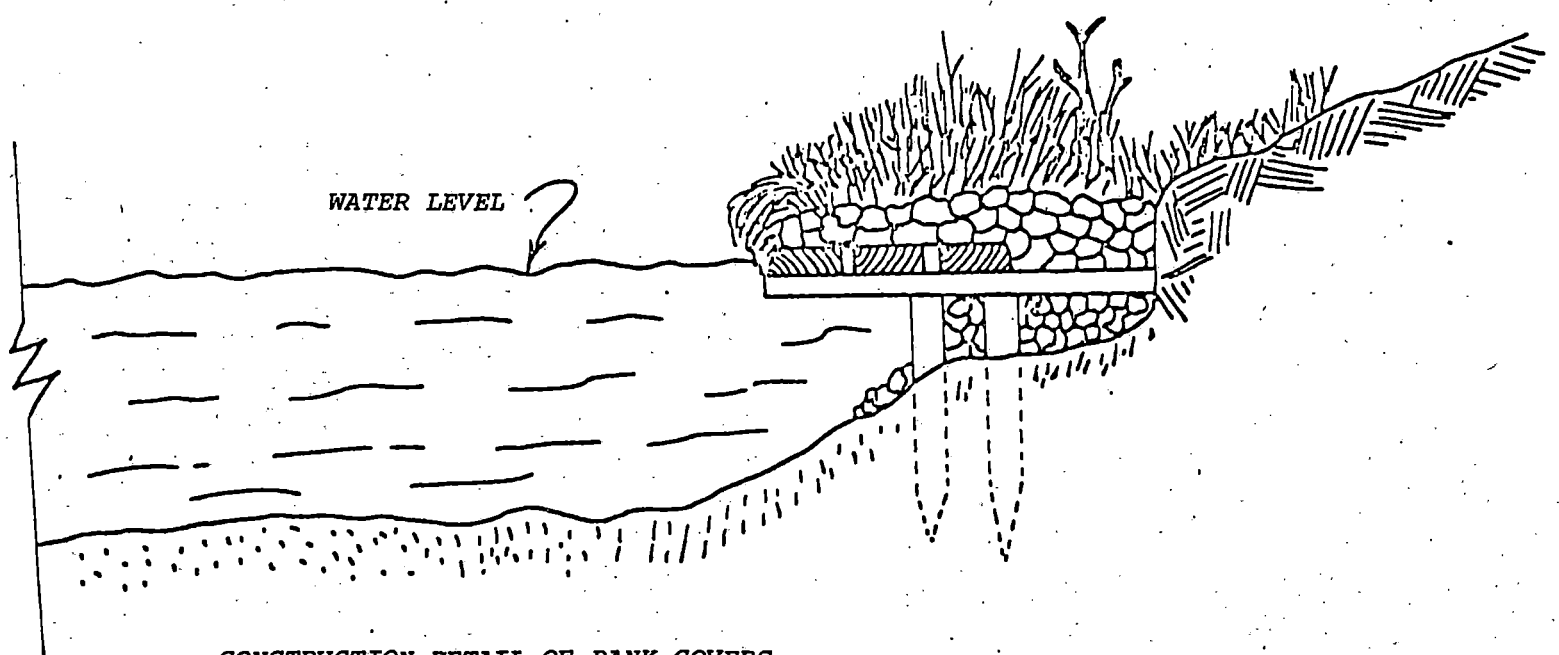


Figure 5

CROSS SECTION OF BANK COVER



CONSTRUCTION DETAIL OF BANK COVERS

Figure 6