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HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY RESEARCH AND WATER RESOURCES

OF THE

COMMITTEE ON INTERIOR AND INSULAR AFFAIRS

UNITED STATES SENATE

NINETY-FOURTH CONGRESS

FIRST SESSION

ON

S. 2361

A BILL TO REAUTHORIZE AND MODIFY McKAY DAM,
UMATILLA PROJECT, OREGON, FOR MULTIPLE FUNC-
TIONS, AND FOR OTHER PURPOSES

OCTOBER 29, 1975



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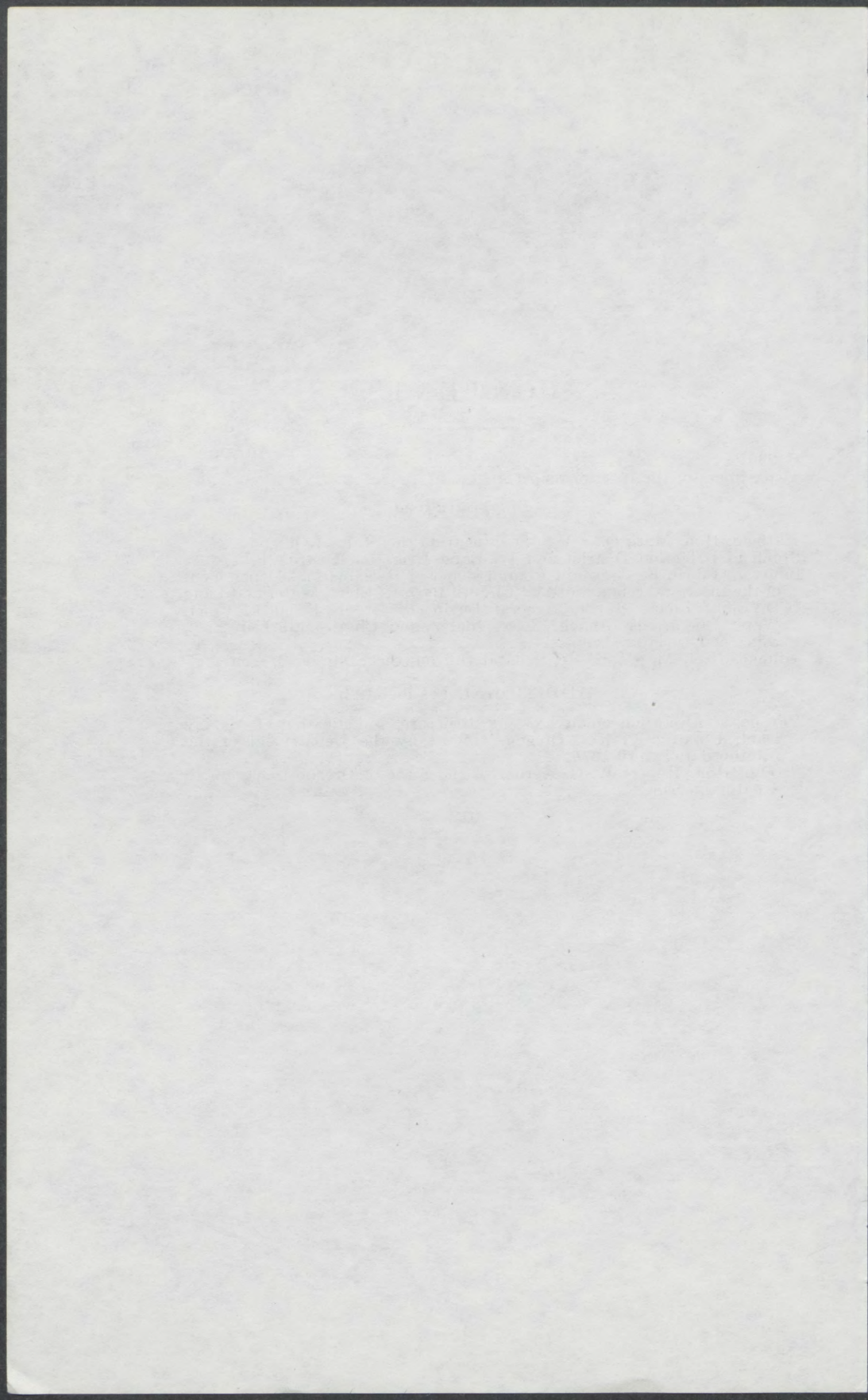
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McKAY DAM, UMATILLA PROJECT, OREGON

WEDNESDAY, OCTOBER 29, 1975

U.S. SENATE,
SUBCOMMITTEE ON ENERGY RESEARCH AND
WATER RESOURCES OF THE COMMITTEE ON
INTERIOR AND INSULAR AFFAIRS,
Washington, D.C.

The subcommittee met, pursuant to notice, at 2 p.m., in room 3110, Dirksen Office Building, Hon. Mark O. Hatfield presiding.

Present: Senator Hatfield.

Also present: Russell R. Brown, professional staff member.

OPENING STATEMENT OF HON. MARK O. HATFIELD, A U.S. SENATOR FROM THE STATE OF OREGON

Senator HATFIELD. The subcommittee hearing will come to order. This is an open hearing of the Subcommittee on Energy Research and Water Resources of the Senate Committee on Interior and Insular Affairs to consider S. 2361, which would reauthorize the McKay Dam of the Umatilla project in Oregon, and authorize the Secretary of the Interior to modify the spillway at McKay Dam.

I introduced this legislation after a review of the report of the Bureau of Reclamation entitled "Modification of McKay Dam," which indicated that unless the spillway is enlarged by nearly three times, area residents face the possibility of major flood damage from an overflow of the reservoir during storms and floods. Methods utilized to estimate potential flood flows have been improved since construction of the dam began in 1923. Prior to that time, the largest peak flow observed of McKay Creek was 3,250 cubic feet per second. This peak has been exceeded on four occasions since 1923; the largest, 7,400 cubic feet per second, occurred in 1965.

Because this is a Federal facility, the Federal Government has a responsibility to take the actions necessary to protect the public from disasters which might result from its deficiencies. In this case, the most reasonable and prudent step is of a preventive nature—the enlargement of the spillway from the existing capacity of 10,000 cubic feet per second to 27,000 cubic feet per second.

We have had ample opportunity to examine the Bureau of Reclamation's study and recommendations and the Congress and the administration must now move expeditiously to protect the public. Failure to act upon the knowledge we now have of the dangers involved is simply inexcusable.

At this point in the record, I would also like to insert the copy of Senate bill 2361 and the copy of the Department's report. I have a

telegram message here from Governor Straub in support of Senate bill 2361, and Congressman Ullman who represents this District of the McKay project, and testimony which was submitted by the Stanfield Irrigation District and the Westland Irrigation District. These will be inserted as well.

[The documents referred to follow:]

[S. 2361, 94th Cong., 1st sess.]

A BILL To reauthorize and modify McKay Dam, Umatilla project, Oregon, for multiple functions, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That McKay Dam and Reservoir, Umatilla project, Oregon, is hereby reauthorized for the purposes of irrigation, flood control, fish and wildlife, recreation, and safety of dams, and the costs thereof shall be re-allocated among these purposes by the Secretary of the Interior, hereinafter referred to as the Secretary, in a manner consistent with the provisions of this Act.

SEC. 2. The Secretary is authorized to perform modifications to the spillway structure at McKay Dam as he determines to be reasonably required for safety of the dam from failure due to overtopping by potential flood inflows to the reservoir.

SEC. 3. Not to exceed six thousand acre-feet of storage capacity in McKay Reservoir shall be allocated for the primary purpose of retaining and regulating flood flows.

SEC. 4. Costs incurred in the modification of McKay Dam to insure its safety from failure shall be nonreimbursable and nonreturnable. All other costs of McKay Dam and Reservoir, heretofore or hereinafter incurred, shall be allocated among the authorized purposes served by the dam and reservoir in accordance with standard cost allocation procedures, and the joint costs allocated to flood control, recreation, and fish and wildlife shall be nonreimbursable.

SEC. 5. The Secretary is authorized to enter into amendatory repayment contracts with the Stanfield and Westland Irrigation Districts, or other water users, if appropriate, to secure the return of reimbursable irrigation construction and operation and maintenance costs arising from the modification and reallocation off McKay Dam and Reservoir.

SEC. 6. There is hereby authorized to be appropriated for modification of McKay Dam the sum of \$1,300,000 (based on July 1975 prices), plus or minus such amounts, if any, as may be justified by reason of changes in construction costs as indicated by engineering cost indexes applicable to the types of construction involved, and, in addition thereto, sums as may be required for operation and maintenance of McKay Dam and Reservoir.

U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., October 29, 1975.

Hon. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs,
U.S. Senate,
Washington, D.C.

DEAR MR. CHAIRMAN: This is in response to your request for the views of this Department on S. 2361, a bill "To reauthorize and modify McKay Dam, Umatilla Project, Oregon, for multiple functions, and for other purposes."

We have reviewed the proposed legislation and recommend against its enactment.

The proposed bill would authorize the Secretary to increase the capacity of the spillway as required for the safety of the dam and would reauthorize the dam to include expanded project functions, for flood control, fish and wildlife, and recreation. The safety features are required as a result of new and updated estimates of possible maximum flood inflows to the reservoir. The storage capacity of the dam would not be increased, although the usefulness of its current capacity would be firmed up and assured by the safety modifications. Appropriations would be authorized in the amount of \$1,300,000, with an inflation clause built in.

The Administration has advised that it considers the project unnecessary. This is not a situation involving a structural defect or weakness in the dam. Rather the

only change in safety factors here is the new, increased inflow design flood, which has a low probability of occurrence. The position of the Administration is that the expenditure here is undesirable and unnecessary, and that an adequate margin of safety can be achieved through operating procedures. The Administration recognizes that this may mean substantial reductions in benefits obtained from the dam and in repayment from the water uses.

The Project.—The Umatilla Project is located along the Umatilla and Columbia Rivers in north-central Oregon. McKay Dam, located about 6 miles south of Pendleton on McKay Creek (a tributary of the Umatilla River), was constructed by the Bureau of Reclamation during the period 1923–27, at a cost of \$2,133,457. The proposal for corrective work was recently made as a result of newly developed meteorological techniques and hydrological data. It was determined that McKay Dam was incapable of storing or passing safely the updated inflow design flood. It was also determined that the same margin of safety could be obtained reserving storage space of 36,000 acre feet (1/2 of capacity) during the storm season until the storm threat passed.

Should an inflow design flood occur without corrective action the dam embankment and spillway parapet wall would be overtopped and rapid breaching of the dam embankment could occur. The discharge from the dam and reservoir could increase from approximately 20,000 cubic feet per second (ft³/s) under flood conditions to as much as approximately 1,500,000 ft³/s in 1 hour or less if the dam failed. The loss of life and property damage downstream from the dam could be disastrous. The flood resulting from dam failure would pass through areas ranging from highly developed urban areas to agricultural and grazing lands. Residences of over 1,100, commercial developments, public facilities, roads, railroad tracks, bridges, and other improvements in the areas of the Montec addition of Pendleton, Reith and Echo would be inundated by the flood.

The proposed modification in the design and structure of the dam would provide a greater factor of safety than was provided by the original design. The spillway capacity would be increased from its present capacity of 10,000 ft³/s to 27,000 ft³/s. Although the reservoir releases would be increased as rapidly as necessary under flood conditions, more time would be available for warning the downstream residents to evacuate. The amount of damage to downstream property and loss of life would be lessened because of the reduction in reservoir releases.

McKay Dam was constructed specifically for irrigation. Throughout the years, other incidental benefits, such as flood control, fish and wildlife, and recreation, have accrued. The proposed bill would authorize allocation of existing costs, as well as the costs of the proposed modification, to the reauthorized purposes of the dam; i.e., irrigation, flood control, fish and wildlife, and recreation.

A copy of the report entitled *Proposed Alteration of an Existing Structure, Modification of McKay Dam, Umatilla Project, Oregon*, dated April 1975 is attached. [See p. 14.] The report describes possibilities for providing irrigation, flood control, fish and wildlife, and recreation and for obtaining appropriate repayment if the project is authorized. The estimated cost of the proposed modification is \$1,160,000 (based upon October 1974 prices), and \$1,300,000 at current (July 1975) prices.

An assessment of the environmental impacts of the proposed construction has been completed, and a negative determination (NDN 75-17 (PN)) was made on June 23, 1975.

As indicated above, however, the Administration is opposed to the project as proposed in S. 2361.

The Office of Management and Budget has advised that there is no objection to the presentation of this report from the standpoint of the Administration's program.

Sincerely yours,

JOHN KYL,
Assistant Secretary of the Interior.

[Telegram]

Hon. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs,
U.S. Senate, Washington, D.C.

DEAR SENATOR JACKSON: The State of Oregon has reviewed the proposed modification of McKay Dam Umatilla project, Oregon, by the Bureau of Reclamation. The reason for the proposed modification is based on new regulations for flood control and dam safety requirements.

McKay Dam was originally authorized as an irrigation project and local irrigation interests have been paying their share of the cost. If in fact the project is reauthorized and modification is undertaken it should be done in such a manner that the local irrigation districts are not responsible for repayment of the cost associated with this modification historically. Flood control has been a non-reimbursable item and it does not appear reasonable to include flood control as a reimbursable item at this time.

Thank you for the opportunity to provide comments for inclusion in the hearing on October 29, 1975.

Sincerely Yours,

GOV. ROBERT W. STRAUB,
Governor of Oregon.

STATEMENT OF HON. AL ULLMAN, A U.S. REPRESENTATIVE FROM THE STATE OF OREGON

Mr. Chairman, thank you for holding hearings on S. 2361 and for providing me with this opportunity to present testimony. The bill would reauthorize and modify the existing McKay Dam, Umatilla project, which is in the Second Congressional District of Oregon about six miles south of the city of Pendleton. The dam is on McKay Creek, which flows northwesterly, around and partially through the Umatilla Indian Reservation, to where it flows into the Umatilla River on the outskirts of Pendleton. There is a large flood plain below the reservation and the dam in an area that has extensive housing and agricultural development.

The dam has been operated by the Bureau of Reclamation since its construction during the period 1923-27. The only authorized purpose for its construction was to provide irrigation to the rich farm lands surrounding the reservoir. Additionally, however, the dam has been helpful for purposes of providing a suitable habitat for the fish and wildlife of the area, significant recreational opportunities and flood control.

The reservoir has a capacity of 73,800 acre-feet and a surface area of 1,290 acres at the normal water surface elevation of 1,322 feet. The dam is an earthfill structure with a reinforced concrete face on the upstream side. The spillway is located on the right abutment. Currently, the capacity of the spillway is about 10,000 cubic feet per second at the normal water level.

When the construction began in 1923, only six years of records on peak flows were available. The largest peak flow was 3,250 cubic feet per second, and the present capacity of the spillway would have been sufficient to handle it. But, since 1923, that peak flow has been exceeded at least four times. On one occasion, a 7,400 cubic feet per second flow was measured.

The Bureau of Reclamation has developed methods of approximating the flow that would occur at maximum flooding conditions. The estimate is that of a peak of 32,800 cubic feet per second. While the maximum is unlikely to ever come about, anything close to it would result in the present spillway being unable to relieve the reservoir of sufficient water to prevent the flow from overtopping the wall. In such event, it is likely that the entire dam would be washed out, destroying property and taking many lives. The Bureau has recognized the potential hazard that exists and has conducted a credible study of the possible alternatives and their costs, environmental impacts, and general desirability. Considered was construction of other dams upstream to either detain a portion of the inflow flood or to develop a replacement water supply to allow a reducing of the active capacity in McKay Reservoir. Additionally considered was a reduction of the active capacity, with a pumping plant on the Columbia River to provide a replacement water supply. A replacement water supply is necessary in the event of a reduction of active capacity if the project is to meet its irrigation purpose. The fourth alternative considered, and the one recommended by the Bureau and incorporated in H.R. 9649, is to increase the capacity of the spillway to 27,000 cubic feet per second.

It has been necessary on several occasions for the flood gate to be opened to an extent that more water was released than McKay Creek downstream could handle and flooding has occurred. The flooding causes a nuisance and results in some property damage. The Bureau has concluded that any of the alternatives would result in damage similar to that presently occurring during peak flows, but it would be considerably less significant than the annual damage that would occur if there were no dam and reservoir at all and certainly in no way comparable to what would result if the dam were washed out.

Of the alternatives considered, the spillway modification would easily have the best benefit-cost ratio and have by far the least construction costs. The bill authorizes the \$1,300,000 (based on July, 1975 prices) necessary to modify the spillway. In comparison, the other alternatives are estimated to require from about 5 to 20 times that amount. The bill would cause the original costs to be allocated among the various uses, but the spillway improvement costs would be nonreimbursable and nonreturnable. The provision regarding the spillway improvement seems appropriate due to the fact that this structural change will not increase the benefits to present users, but corrects a dangerous situation that stems from a project constructed under Federal authorization. The precedent for this arrangement includes the Brantly in New Mexico and the Belle Fourche in South Dakota.

Again, thank you for your consideration of this matter.

STATEMENT OF STANFIELD IRRIGATION DISTRICT AND WESTLAND IRRIGATION DISTRICT

Mr. Chairman, the above Irrigation Districts are vitally concerned with the subject matter of H.R. 9649 and they appreciate the opportunity of offering written testimony about it. The fact that testimony is presented by letter rather than in person should not be considered as a lack of interest but rather as a reflection of short notice and very thin budgets. Hopefully, the position of the Districts will be clearly presented in this letter.

There are several questions about McKay Dam which have concerned the Districts in recent years. With one possible exception, these questions appear to be answered in H.R. 9649. The first question is whether spillway modification will be required and if so, who will pay for it. The Bill answers that spillway modification will be made for safety purposes and consequently, the Districts will not be obligated to pay any of the modification costs.

The second question is whether there will be a reauthorization of the purpose of the Dam and Reservoir which was originally authorized only for irrigation use. If there is such a reauthorization of purpose, will there be a corresponding reallocation of cost and expense. The Bill reauthorizes the Dam and Reservoir to include the following uses in addition to irrigation: flood control, recreation, fish and wildlife and safety of the Dam. All costs and expenses properly allocated to such new uses shall be nonreimbursable and the Districts will not be obligated to pay any of those allocated costs.

The third question is whether a reauthorization of use and reallocation of cost and expense will result in any reduction in irrigation water available to the Districts. The two Districts have presently contracted for 60% of the space in McKay Reservoir on a permanent basis and for 15% on a temporary basis. Additionally, there is another 16% (12,100 acre feet) of the space reserved by the Bureau from any contract. The Districts have a critical need not only for the 60% permanently contracted for but also the 15% which they have been using on a temporary basis (for approximately 25 years). The districts are also hopeful that they can permanently contract for some portion of the reserved 12,100 acre feet of space. The history of the Reservoir operation establishes that the Districts can, if they have the space presently available, carry-over water from an unusually wet year to save the irrigators during subsequent normal dry years. This practice maximizes the use of the water and prevents substantial loss of crops.

The only specific reference in H.R. 9649 to a reduction in space available for irrigation water is the 6,000 acre feet exclusive allocation to flood control. If this is the maximum amount of space which can ever be utilized for non-irrigation purposes the Districts have no objection to the proposal. In fact, this has been the operating procedure of the Bureau for the last several years and it is a workable arrangement.

The specific question which the Districts now have and their principal apprehension with H.R. 9649 is this: since the Secretary will now be authorized to allocate a percentage of costs to, for example, fish and wildlife, which costs are non-reimbursable, can the Secretary then allocate a percentage of the space in McKay Reservoir to the exclusive use of fish and wildlife. The Bill neither permits nor prohibits such a reservation of space. If, through H.R. 9649, the Districts could lose any portion of the 75% space presently contracted for, the Districts are in total opposition to the Bill. The loss of any irrigation water by the Districts will most certainly jeopardize the economic survival of the Districts and their members.

The Districts appreciate that the only specific reallocation of space is the 6,000 acre feet allocation to flood control. The Bill may well prohibit any other reallocation of space merely by its failure to specifically authorize them, but we don't know this for sure and the question is too important not to be asked.

If the Bill authorizes the Secretary to make any allocation of space to uses other than irrigation or flood control (6,000 acre feet) or if there is any doubt as to the Secretary's implied authority to make such allocation the Districts oppose H.R. 9649. Otherwise, they support it.

Thank you for your interest in these problems and your assistance in solving them.

STANFIELD IRRIGATION DISTRICT,
WESTLAND IRRIGATION DISTRICT,
by ROBERT E. O'Rourke, *Attorney*.

Senator HATFIELD. Now, I would like to call Mr. Edwin F. Sullivan, Assistant Commissioner of Reclamation, as the witness for the Department of the Interior.

STATEMENT OF EDWIN F. SULLIVAN, ASSISTANT COMMISSIONER OF RECLAMATION, DEPARTMENT OF THE INTERIOR, ACCOMPANIED BY CLIFFORD BARRETT, CHIEF, WATER AND LAND DIVISION; EDGAR ROPER, GENERAL ENGINEER; JEROME SCHAACK, CHIEF, WATER OPERATIONS BRANCH, BOISE, IDAHO; AND CHARLES MARKELL, ESQ., OFFICE OF LEGISLATIVE COUNSEL

Mr. SULLIVAN. Good afternoon.

Senator HATFIELD. We are very happy to welcome you here today, Mr. Sullivan. And for the record, would you please introduce your colleagues accompanying you.

Mr. SULLIVAN. Yes. On my left is Jerome Shaack who is from the Bureau of Reclamation Office of Boise and has had direct association with the McKay project. And Clifford Barrett, who is the Chief of the Water and Land Division in the Bureau of Reclamation here in Washington.

Senator HATFIELD. Welcome. We are happy to have you gentlemen here today. Would you like to summarize or would you care to read your statement, or proceed, please, as you care to.

Mr. SULLIVAN. OK. My statement is relatively short. I think, maybe, I will read it.

Mr. Chairman, we are appearing today to present the administration's views on S. 2361, a bill to reauthorize and modify McKay Dam, Umatilla project, Oregon, for multiple functions, and for other purposes.

The administration recommends against enactment of the bill. The reasons for this are described in the Department's report on the bill.

Since passage of the Reclamation Act of 1902, the Bureau of Reclamation has built more than 230 storage dams. Reclamation has a Safety of dams program which includes activities such as periodic field reviews of maintenance of its dams by qualified engineers, instrumentation and analysis of periodic readings to detect unusual occurrences within the dams adjacent to the dams and reservoirs.

When the program reveals the need for corrective action to make a dam safe through operational or structural modifications, studies and recommendations are made on a case-by-case basis. McKay Dam

has been identified as one of the reclamation dams most in need of corrective measures to make it safe. McKay Dam is a feature of the Umatilla project in north-central Oregon. It is located on McKay Creek about 6 miles south of Pendleton, Oreg.

The dam was constructed by the Bureau of Reclamation during the period 1923-27, at a cost of \$2,133,457. At the normal water surface elevation of 1,322 feet and a surface area of 1,290 acres. The reservoir is part of the McKay National Wildlife Refuge Area which, incidentally, was established in 1927 at the time the dam was completed.

The outlet works has a capacity of approximately 1,500 cubic feet per second at water surface elevation 1,322 feet. The spillway, located on the right abutment, consists of a gated side overflow and a twin barrel siphon inlet structure and chute. The crest of the side overflow inlet structure is at elevation 1,312 feet and is controlled by six 20-foot wide by 10-foot high radial gates.

The design capacity of the spillway is approximately 10,000 cubic feet per second at water surface elevation 1,322 feet. The side overflow section has a design capacity of 9,000 cubic feet per second, and the twin barrel siphon has a design capacity of 1,000 cubic feet per second. However, recent studies indicate that the siphon capacity is approximately 680 cubic feet per second.

Through the utilization of modern meteorological and hydrological techniques, the Bureau of Reclamation has recently determined that the inflow design flood at McKay Dam is greater than was estimated when the structure was designed and constructed. Based upon current data, the inflow design flood has a peak flow of 32,800 cubic feet per second and a 5-day volume of 98,600 acre-feet.

Many lives could be lost and much property would be destroyed or damaged extensively if a flood approaching the magnitude of the inflow design flood should occur before corrective action is taken at McKay Dam. The embankment of the dam and the spillway parapet would be overtopped.

Flows across the crest of the embankment would cause rapid erosion of the gravel fill, and the spillway parapet and lining on the upstream face would be undercut. Wave action in the spillway chute would overtop the walls and erode the abutment and dam embankment adjacent to the walls. In matter of minutes after the dam was overtopped, erosion of the noncohesive embankment would create a breach in the dam extending to the reservoir floor.

In 1 hour or less after the dam was breached, the reservoir discharge would increase from 20,000 to about 1,500,000 cubic feet per second. In about 2 hours, the reservoir would be empty and the discharge would be equal to the reservoir inflow. A detailed channel routing of the dam failure flood indicated that the peak flow in McKay Creek would be reduced to approximately 1,180,000 cubic feet per second as it entered the Umatilla River.

A routing study of lesser detail indicates that the peak flow in the Umatilla River at its confluence with the Columbia River would be approximately 560,000 cubic feet per second.

The major threat to life and property exists in the area adjacent to the 5-mile long reach of McKay Creek below McKay Dam. The flood plain includes some small farms and a highly developed urban area—Montee addition—close to Pendleton. The area is developing

at a rate faster than the rest of the region. About 270 homes would be flooded.

Other major developments in the flood plain include a bowling alley, Pendleton's sewage treatment plant at the mouth of McKay Creek, U.S. Highway 395, and numerous roads and bridges.

Within the area along the Umatilla River below the mouth of McKay Creek are approximately 3,500 acres of agricultural land, the towns of Reith, Echo, Stanfield, Hermiston, and Umatilla, many farmsteads, and numerous commercial developments. Approximately 152 homes and the stores, churches, and schools at Echo would be flooded.

A sawmill, two grain elevators, a camper-trailer manufacturing plant, a seed mixing-processing facility, 15 miles of the main line of the Union Pacific Railroad, 4 miles of Interstate 80, the Pendleton-Echo highway, and other service roads would be damaged by the flood.

The modification at McKay Dam proposed in S. 2361 is to increase the capacity of the existing spillway. Such a plan would involve an enlargement of the spillway from 10,000 to 27,000 cubic feet per second and would consist of the following construction:

1. Widening of the spillway chute from 16 feet to 45 feet in the vicinity of the spillway gate structure to increase its hydraulic capacity.
2. Raising and extending an existing wall at the right abutment of the spillway gate structure to prevent overtopping of the wall.
3. Relocating the spillway gate hoists to allow the gates to be opened an additional 3 feet vertically.

The spillway modification would not prevent damaging flows downstream from the dam during an inflow design flood, but the modifications would insure against the catastrophic flood resulting from dam failure. The potential loss of life would be greatly reduced.

Several alternatives to enlarging the spillway were also considered, including reserving a storage space of 36,000 acre-feet during the storm season until the flood threat passed. The latter proposal would protect the safety of the dam, but would require about one-half of the reservoir space and would seriously impair project benefits.

McKay Dam and Reservoir were constructed for the single purpose of irrigation. At present, the 73,800 acre-feet of active storage in the reservoir is allocated to irrigation, with 50,249 acre-feet under long-term contract, 11,395 acre-feet reserved from permanent disposition pending further determinations, and a residual space of 12,156 acre-feet.

The annual irrigation benefits resulting from the use of water in the Stanfield and Westland irrigation districts and by individual contractors are estimated at \$255,000. Irrigation entities have expressed a strong interest in using all of the space which is not under long-term contract.

Throughout the years, other benefits such as flood control, recreation, and fish and wildlife have accrued from reservoir operation. Estimates regarding these benefits have been prepared based on the assumption the present storage capacity of the reservoir would continue to be usable.

A preliminary reconnaissance estimate by the Corps of Engineers indicates that the average annual flood control benefit of the modified

dam would be at least \$160,000. The Bureau of Outdoor Recreation estimates that the annual benefit to recreation is \$36,000. The Fish and Wildlife Service estimates that the annual benefit to fish and wildlife is \$159,000.

As indicated previously, the administration recommends against enactment of the bill.

Thank you.

I will be glad to answer any questions that you may have.

Senator HATFIELD. Thank you very much Mr. Sullivan for the excellent statement with the exception of the second paragraph on page 1, for which, I am sure, you have little or no control. That is not a question.

Mr. SULLIVAN. Thank you.

Senator HATFIELD. You may ignore that. I have before me not only your statement in which it is obvious that you have carefully considered various alternatives. I assume my reading is correct when I read that these alternatives, at some point in the consideration of this proposal, were rejected, at least, on the technology and the engineering data.

And, what we are now confronted with is one of those unhappy situations where your professional hat certainly recommends one way, and the budgetary forces that are part of the executive branch of Government have taken another position. That is also an observation. It does not necessitate a response.

I would like to have you, first of all, explain the phraseology "inflow design flood." I think on page 3 in the top paragraph, you have used, it says, "Through the utilization of modern meteorological and hydrological techniques, the Bureau of Reclamation has recently determined that the inflow design flood at McKay Dam is greater than it was estimated."

Would you explain, for the record, what inflow design floods are? How they are interpreted? What do they mean, what is their purpose, and so forth?

Mr. SULLIVAN. In the construction and design of any dam, one of the requirements is to determine the amount of flood inflow that could determine and for which a spillway or surcharge storage needs to be provided in order to prevent the dam from flooding. In other words, if a very large flood should occur, you need to have the facilities in the dam or storage in the dam so that that flood can be regulated, and it will not overtop and cause the dam to fail.

So, for every dam, we make a determination of what we call the inflow design flood. That is done on the maximum probable flood. Then, it is routed over the drainage basin and through the reservoir and a determination is made as to what provisions should be included in the dam in order to make it safe from failure.

When McKay Dam was designed, over 50 years ago, the procedures they ran were not so sophisticated as they are now. We have a lot more record and we know that the potential for a flood flow there is much greater than is now estimated by modern standards.

So, at the time the dam was built, 4,000 feet of spillway capacity was provided. But, based on modern approaches to this problem, the larger flood would be needed to be protected against.

Senator HATFIELD. We have here before us this rather graphic presentation in the form of a map of the McKay Dam spillway modification. Would you point out, on that map, some of the actual results of what we could expect in case of a failure of the dam.

Mr. SULLIVAN. I think by looking at the map you can say that McKay Dam is located in the lower right-hand corner of McKay Creek near Pendleton. Then, the creek flows for about 5 miles down to Pendleton then into the Umatilla River, and goes for, maybe, 30 or 40 miles, and then gets into the Columbia River. The area colored in red is the area that would be subject to inundation if the dam should fail. It is a rather extensive area, and it would be rather catastrophic because if the dam failed, the water would surge out in a great amount. There would be a great wall of water that would go down through there. In the area, there are some 300 or 400 homes. Well over 1,000 people. And, if the dam should fail, I think it is quite certain that there would be considerable loss of life because there would not be too much warning.

Senator HATFIELD. No. I have some feedback that indicated that there was some question in the minds of certain individuals that this capacity is too great for the down stream area. This amount of water cannot be handled.

I think you have given the answer to this, but what is the alternative?

Mr. SULLIVAN. What I described is what would happen if the dam failed. Now, if the spillway, or rather, if the flow is regulated somewhere or other there, or a very large flood occurs, there still would be extensive flood damage in this same area; but not nearly as much as if the dam failed. There would be, considerably, more warning because the flow would build up more gradually and then lower down more gradually. There would not be nearly so much of this idea of a surge or a wave going down there.

So, I think the difference that would occur, assuming the same size flood with a dam failing as the dam not failing, is that the area flooded would be somewhat larger with a dam failing. The property damage would be so much larger, but there still would be property damage otherwise. There probably would be extensive loss of life if the dam failed, and probably not very much or none at all if the flood just went through itself, because there would be more warning. A warning could be gotten out to the people who live in the area.

Senator HATFIELD. So, the way you analyze it, you have to come down on the side of the enlargement and modification, and the standpoint of the safety of people.

Mr. SULLIVAN. Yes, Not counting the safety of people, we have an estimate. We have made an estimate with the assistance of the Corps of Engineers that there would be damage, \$8 million over and above, due to the failure of the dam. Over and above what would occur from the flood if the dam did not fail.

Senator HATFIELD. Since this decision to reject the project is the position of the administration, as made by OMB, I assume that OMB had all of this data and material—had the experts that would understand what inflow design techniques and what new technology was available that you had made these judgments on. I presume that OMB had all of these qualified individuals. Were you on this project?

Mr. SULLIVAN. I don't know whether OMB contends that it has people—experts—in the field of hydrology and dam design. However, they did have our reports and we did prepare a report this last summer. They had that. They did ask us a number of questions and, perhaps, a number of others.

Senator HATFIELD. You are standing by the report here that was prepared in the field which indicated the kind of devastation this would have, not only on property, but also the loss of storage water. Included on page 17 of the report, dated April 1975, a loss of storage water would diversely affect our irrigators receiving water from McKay Reservoir. It would essentially eliminate fish benefits.

So, we are talking about irrigation—the problems of irrigation—the problems of flood control; the problems of fisheries; the problems, most of all, of potential loss of life.

Mr. SULLIVAN. Recreation.

Senator HATFIELD. Yes. So, we are talking about, in effect, almost the total concept of a multipurpose project.

Mr. SULLIVAN. Yes. I don't think there is any dispute with the facts that are presented in the report there.

Senator HATFIELD. Right. I think OMB's minds were made up before they had the facts, and they did not have the ability to work that into the facts. That is my judgment.

I think this is another illustration of where we had some accounting mentalities trying to make judgments on a project that calls for a qualified person with credentials in hydrology and engineering ability. Obviously the project is being rejected, not on the basis of the facts or the merits of the case or engineering of the case, but purely on the ledger. I have found so many examples of the OMB having expenditures as its sole concern—expressing so little interest in the people aspects of projects. The OMB looks at dollars versus people and comes down hard on the side of dollars.

Resource management, generally, has suffered through the meat grinder of the OMB. But, maybe we can outflank them on this as we have on other projects where we have the backing of qualified engineers, experts such as yourself, who think this project qualifies on the basis of cost benefit and other such measurable explicit data.

I want to commend you, again, on a very outstanding report. I would like to read from the interesting letter signed by the Assistant Secretary of Interior representing the administration.

He says in this letter dated October 29 to our chairman, Mr. Jackson, in the third paragraph the bottom line, it says "that an adequate margin of safety can be achieved through operating procedures."

But first of all, I would like to ask you, what are operating procedures? Something that you can do operationally to deal with the problem, and what would those operating procedures have as impact upon the project as a whole?

Mr. SULLIVAN. One of the alternatives that was considered to take care of the inflow design flood was to reserve space in the reservoir to regulate that flood. And, we did find out that it could be handled if 36,000 acre-feet of space were held empty for that purpose. That, of course, is half the storage space of the reservoir. Almost half the storage space in the reservoir.

And, while that would be possible, it would have a significant adverse effect on the other project benefits, particularly, irrigation, fish and wildlife, and recreation.

Senator HATFIELD. What kind of effect did you say it would have?

Mr. SULLIVAN. Adverse.

Senator HATFIELD. Would you expand on that word adverse a little bit?

Mr. SULLIVAN. I don't have any numerical computations on that effect, but I think it would be very serious. It would reduce the water supply for the irrigators. They already have an inadequate supply. So, they undoubtedly would end up with considerably less opportunity for crop production. It would affect them economically. I imagine that some would not survive economically although I don't have—we have not developed specific data on that.

The reservoir would be emptied much more often than it is now which would have very serious adverse effects in reducing the amount of fisheries and the reservoir and wildlife benefits, and also, recreation. I think the most serious, however, would be to the irrigators because, as I mentioned, they already are limited in the supply they have. And, if their irrigation supply is reduced, the crop production in that area would be seriously curtailed, and it certainly would affect them in a way that maybe some of them would not even be able to continue their operations.

Senator HATFIELD. Mr. Sullivan, as I listen to your gentle description of the adverse impact, would you argue with me too much if I observed, in my opinion as a layman, it sounds as though this would render the whole project worthless.

Mr. SULLIVAN. I would have to say it would not be completely worthless, but it would be almost that.

Senator HATFIELD. In other words, you would not argue too hard with me on that observation?

Mr. SULLIVAN. No.

Senator HATFIELD. The staff has just pointed out to me that in your study, your proposed alteration, that on page 28, that under the proposed structural modification of the McKay Dam you compute a benefit cost ratio of 6.6. which is I am told again by staff, the highest benefit ratio that has been brought before this committee for a project in several years.

Mr. SULLIVAN. I think that is a favorable ratio. It does indicate the values that could come from continuing the project in service with the facilities that were proposed in the Bureau of Reclamation report.

Senator HATFIELD. I'm going to draw a parallel between your observation of using the word favorable in such a very understated way as to the way you use adverse; 6.6 is pretty strong, and, I think the adverse impact would be equally strong.

I think it is also interesting, Mr. Sullivan, and I am sure you have read this carefully, that in this same letter signed by the Assistant Secretary of the Interior saying they are rejecting the project, or disapproving it. They, having suggested the operation procedures, they state in the very next sentence "The Administration recognizes that this may mean substantial reductions in benefits obtained from the dam and a repayment from the water users."

This, again, is bureaucratic gobble-dy-gook which says it is worth less, in my opinion as I read it. Do you have any suggestion as to any amendments that might make the bill acceptable to the OMB?

Mr. SULLIVAN. My understanding of the administration's position is that they plain oppose the bill.

Senator HATFIELD. Thank you. Mr. Schaack. Do you have any comments to make?

Mr. SCHAACK. No, sir.

Senator HATFIELD. Mr. Barrett?

Mr. BARRETT. No, thank you.

Senator HATFIELD. I have some comments, but I don't think this will be an appropriate place to say that.

Gentlemen, we appreciate very much your presence here today as for an outstanding research programing that you have done in your report here. It is befitting the high reputation of your agency to do its homework and come up before these committees well prepared, bringing basic data and engineering studies, and recommendations.

I am very hopeful that we may have a chance to work with you in this project to overcome some of the obstacles that are presently in our path. I appreciate, very much, your time and your efforts.

Mr. SULLIVAN. Thank you, Mr. Chairman.

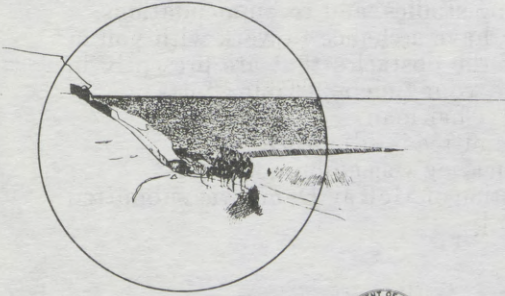
Senator HATFIELD. The subcommittee is adjourned.

[Whereupon, at 2:40 p.m., the hearing was adjourned.]

[The following report "Modification of McKay Dam" was submitted by the Department of the Interior.]

PROPOSED ALTERATION OF AN EXISTING STRUCTURE

MODIFICATION OF McKAY DAM



UMATILLA PROJECT
OREGON



DEPARTMENT OF THE INTERIOR
Rogers C.B. Morton, Secretary



BUREAU OF RECLAMATION
Gilbert G. Stamm, Commissioner

Proposed Alteration of an Existing Structure

MODIFICATION

OF

MCKAY DAM

Umatilla Project

Oregon

BUREAU OF RECLAMATION



Gilbert G. Stamm
Commissioner



Rodney J. Vissia
Regional Director
Pacific Northwest Region
Boise, Idaho

April 1975

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IN REPLY
REFER TO: 430/720
510.

United States Department of the Interior
BUREAU OF RECLAMATION

PACIFIC NORTHWEST REGIONAL OFFICE
FEDERAL BUILDING & U.S. COURTHOUSE
BOX 043-550 WEST FORT STREET
BOISE, IDAHO 83724

April 28, 1975

Memorandum

To: Commissioner
From: Regional Director, Boise, Idaho
Subject: Safety of Dams--Report on Proposed Modification of McKay Dam,
Umatilla Project, Oregon--Examination of Existing Structures
Program

INTRODUCTION

This is a report^{1/} on the proposed modification of McKay Dam on McKay Creek in northeastern Oregon to insure the safety of the structure during the occurrence of the updated inflow design flood. The modification would increase the capacity of the existing spillway by modifying the gate structure and increasing the width of the spillway chute. The estimated cost of the modification work, based upon October 1974 prices, is \$1,160,000.

The report presents information on the present situation related to the safety of McKay Dam and Reservoir, the alternatives considered, and the proposed structural modification.

The preliminary report was forwarded to all interested Federal and State agencies and other entities for their review; any pertinent comments were considered and incorporated into this final report.

^{1/} Authorized to be made by the Federal Reclamation laws (Act of June 17, 1902, 32 Stat. 388, 43 U.S.C., 391, and acts amendatory thereof and supplemental thereto).



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PRESENT SITUATION

Explanatory Statement

As a part of the Examination of Existing Structures Program, a study has been made to determine the adequacy of McKay Dam and Reservoir to safely handle an inflow design flood determined on the basis of new hydrologic information and present-day procedures. A study utilizing newly developed technology was also made to determine the adequacy of the dam embankment to withstand the maximum credible earthquake at this location.

Need for Structural Modification

The seismic study indicates that the dam embankment would withstand the maximum credible earthquake without dam failure. However, hydraulic and structural studies show that the dam and spillway would be overloaded by the new inflow design flood and could fail, resulting in very rapid loss of reservoir storage and catastrophic consequences downstream. The manner and consequences of dam failure are described in the section titled, "Need for Corrective Measures."

Extensive urban development of the flood plain along McKay Creek below McKay Dam has taken place since construction of the dam. The development, to a large extent, has resulted because of flood control provided incidentally through normal operation of McKay Reservoir. Annual flood peaks have been eliminated or greatly reduced in nearly each year since construction of the dam.

Failure of McKay Dam and the resulting flood would be disastrous primarily for three reasons. First--and most important--the threat to the lives of many people located in the flood plain; second the threat of damage to property downstream; and, third the risk to the existing Umatilla Project. The probable losses are discussed in detail later in the report.

The Federal Government has the responsibility to see that remedial action is taken because the dam was designed and constructed by a Federal agency under Federal Reclamation laws and is operated and maintained by a Federal agency.

DESCRIPTION OF THE UMATILLA PROJECT

General

The Umatilla Project is located in north-central Oregon northwest of the city of Pendleton along the Umatilla and Columbia Rivers, as shown on the Umatilla Project maps, plates 1 and 2. The project has proven to be a worthwhile development to local, state, and national participants providing a gross annual crop value in excess of \$2 million as well as other economic and sociological benefits.

Project features include McKay Dam and Reservoir on McKay Creek, offstream Cold Springs Dam and Reservoir, three diversion dams on the Umatilla River, and three canals totaling about 62 miles in length. McKay Dam and Reservoir are operated by the Bureau of Reclamation, and the remainder of the project facilities are operated by four irrigation districts--Hermiston, West Extension, Stanfield, and Westland.

Approximately 34,600 acres of land are irrigated by the project: 18,000 acres within the Hermiston and West Extension Irrigation Districts receive a full water supply from Cold Springs Dam and Reservoir and natural and floodflows in the Umatilla River; 13,000 acres in the Stanfield and Westland Irrigation Districts receive a supplemental water supply from McKay Reservoir; and 3,600 acres are provided either full or supplemental water from McKay Reservoir under individual storage contracts.

McKay Dam and Reservoir

McKay Dam is located on McKay Creek about 6 miles south of Pendleton, Oregon (see plates 1 and 2). The dam was constructed by the Bureau of Reclamation during the period 1923-27 at a cost of \$2,133,457. Storage of water in McKay Reservoir was begun in 1927. The reservoir has an active storage capacity of 73,800 acre-feet and a surface area of 1,290 acres at normal water surface elevation 1322 feet. The dam and reservoir were constructed for the single purpose of irrigation. Incidental benefits for flood control, fish and wildlife, and recreation are derived from the reservoir. The reservoir is part of the McKay National Wildlife Refuge area.

Under existing repayment contract arrangements, the Stanfield and Westland Irrigation Districts are entitled to 60 percent (44,280 acre-feet) of the active capacity; 15 percent (11,070 acre-feet) has been reserved from permanent disposition pending the determination of the terms and conditions on which such space will later be made available on a permanent basis. Also, individuals have contracted for 5,969 acre-feet under long-term agreements, and 325 acre-feet of the capacity are reserved from permanent disposition under contracts which may be terminated upon 6 months' written notice. The following tabulation

summarizes the quantity of storage under long-term contracts and the capacity which could ultimately be marketed.

	<u>Acre-feet</u>	<u>Percent</u>
Total active capacity	73,800	100.0
Less: Capacity currently under long-term contracts	-50,249	-68.0
Irrigation districts	(44,280) ^{1/}	(60.0)
Individuals	(5,969)	(8.0)
Capacity which could ultimately be marketed	23,551	32.0
Capacity now reserved from permanent disposition	-11,395	-15.5
Irrigation districts	(11,070) ^{2/}	(15.0)
Individuals	(325) ^{3/}	(0.5)
Residual capacity	12,156	16.5

^{1/} Stanfield I.D. = 22,140 ac-ft

Westland I.D. = 22,140 ac-ft

^{2/} Stanfield I.D. = $\frac{3,690}{25,830}$ ac-ft (5%)

Westland I.D. = $\frac{7,380}{29,520}$ ac-ft (10%)

^{3/} This space is currently under contract with two entities whereby termination of the agreement may be made by either the U.S. or the water user upon 6 months' written notice.

Storage water is released on order from these two districts and from several small groups and individual users with storage rights. The Bureau has no direct responsibility for the distribution of stored water since the districts operate their own canal systems.

McKay Dam is an earthfill structure containing about 2,364,000 cubic yards and has a reinforced concrete paved upstream face. It has a structural height of 165 feet and a hydraulic height of 152 feet. The crest of the dam is 2,700 feet long at elevation 1330 feet and has a width of about 20 feet. A photograph on plate 3 shows the dam and spillway, and a drawing of McKay Dam is shown on plate 4.

The outlet works is a concrete-lined tunnel in the right abutment with a capacity of approximately 1,500 cubic feet per second at normal water elevation 1322 feet. Releases are controlled by two 4-foot and

one 10-inch needle valves. The 10-inch valve is used for direct diversions into the Marion-Jack Ditch.

The spillway, located on the right abutment, consists of a gated side overflow and twin barrel siphon inlet structure and chute. The crest of the side overflow inlet structure is at elevation 1312 feet and is controlled by six 20-foot by 10-foot radial gates. The capacity of the spillway is about 10,000 cubic feet per second at water surface elevation 1322 feet. The side overflow section has a design capacity of 9,000 cubic feet per second and the twin barrel siphon was designed for 1,000 cubic feet per second. Recent studies indicate that the siphon capacity is less than indicated above; the capacity is estimated to be 680 cubic feet per second. Photographs, plates 5 and 6, show the spillway.

The concrete on the upstream face, in the parapet wall on the crest of the dam, and in the spillway is in a satisfactory condition. The outlet gates, valves, and pipes are in good condition. Seepage flows at the downstream toe of the dam vary with reservoir storage, but the rate of flow is not excessive and the seepage water continues to remain clear indicating that objectionable erosion is not occurring.

INFLOW DESIGN FLOOD

Procedures and techniques used in determining inflow design floods have been greatly improved since design and construction of McKay Dam. Furthermore, considerably more streamflow and climatic data, including snow cover, are now available.

Present-day flood hydrology practices include the careful evaluation of the several complex factors and conditions which influence flood runoff. These are: storm rainfall, snowmelt, the combination of rain and snowmelt, and infiltration loss which in turn is a function of soil type and condition, geology, and vegetal cover. In present-day studies, the unit hydrograph procedure, requiring detailed analyses of stream gage recorder charts, is used to convert the design rainfall and snowmelt quantities into the resulting inflow design flood runoff hydrographs. Design floods are often computed for more than one probable combination of design storm and ground condition when it is not otherwise apparent which occurrence would be the most critical to the safety of the dam. The required spillway capacity is then determined by studies in which the inflow design flood is routed through the reservoir.

In many instances, the current procedures result in higher estimates of potential flood flows and required spillway capacity than the earlier methods which were based on very few years of record. The new inflow design flood estimate for McKay is greater than the original estimate, partly because of the magnitude of the storms and floods which have occurred in recent years. These events have provided not only more detailed data than were available in 1923, but also give better definition of the probable critical conditions for flood generation. Prior to 1923, when only 6 years of record were available, the largest peak flow observed on McKay Creek was 3,250 cubic feet per second. This peak has been exceeded on at least four occasions since 1923; the largest, 7,400 cubic feet per second, occurred on January 30, 1965.

From a study of several possibilities, it was concluded that the most critical flood-producing condition for the watershed above McKay Dam would be a winter rain-on-snow event materializing at a time when the soils of the unforested portion of the watershed are deeply frozen. The design winter storm for this inflow design flood was derived through analysis and maximization of the storms of May 26-30, 1906, and March 28-April 2, 1931. Wind speeds and temperatures associated with the design rainfall were also determined for use in computing the rates of snowmelt during the storm period. The unit graph method was then applied to that portion of the rainfall and snowmelt estimated as available for runoff. The resulting inflow design flood has a peak of 32,800 cubic feet per second and a 5-day volume of 98,600 acre-feet.

The inflow design flood was routed through the reservoir with the existing structures (see plate 7). It was assumed that at the start of

the flood the reservoir would be full (water surface elevation 1322 feet), and that the outlet works and spillway would be operated to maintain an elevation of 1322 until their combined capacity was fully utilized. The routing study shows the maximum water surface would rise to elevation 1333.4 or 0.9 feet above the top of the parapet. The maximum spillway discharge would be 18,500 cubic feet per second, nearly twice its design capacity. The maximum outlet works discharge would be about 1,500 cubic feet per second. About 8,600 cubic feet per second would flow over the parapet and dam embankment.

SEISMIC EVALUATION

The effect of seismic loadings on McKay Dam was determined using newly developed procedures which are more indicative than those available at the time the dam was designed. These procedures include estimating the maximum credible earthquake expected to affect the site and the ground motion beneath the dam. The calculated dynamic response of the dam to the ground shaking is used as the basis for evaluating the adequacy of the embankment to withstand this hypothetical earthquake.

Conclusions

The seismic evaluation indicates that the dam embankment would adequately resist the maximum credible earthquake for this location without dam failure. Surficial slumping of the downstream slope and some cracking in the upstream concrete face would probably occur. Such damage would not result in loss of reservoir storage and is considered to be repairable. There are no apparent landslide areas near the reservoir of sufficient size to produce waves which could overtop the dam.

Geology and Seismology

McKay Dam, located in a moderately seismic zone of the Columbia Basin geologic province, lies in the southern part of a mildly deformed tectonic belt, referred to as the Olympia-Wallowa Linement. The most severe historical seismic event to affect the dam vicinity was the 1936 State Line earthquake. The magnitude of this event was 5.75 (Richter scale), with the epicenter located about 30 miles north of the dam. Intensity V (Modified Mercalli) ground shaking was experienced in the dam vicinity during this event. The nearest recorded seismic event was a weak earthquake in 1922 located 6 miles north of the damsite. This event had an Epicentral Intensity of III.

The dam has a foundation of sound unfaulted basalt and well-cemented fanglomerate.

The maximum credible earthquake for the vicinity of McKay Dam has a magnitude of 6-1/2 and a focal depth of 25 miles.

Embankment Seismic Analysis

The dynamic response analysis of the embankment section utilizes the finite element method and dynamic soil properties to calculate the mode shapes and natural frequencies of the structure and the stresses and strains. The combined static and dynamic strains are not found to be excessive for this embankment. Accelerations as high as 0.2g may be expected at the crest of the dam from the maximum earthquake.

McKay Dam has incorporated in its design several features which enhance its earthquake resistance. The embankment material is classified as being very good for resistance to concentrated leaks. High density compaction was apparently obtained by techniques, materials, and equipment used during construction. The dam foundation is strong and consists of materials not expected to lose strength when shaken. The concrete facing is in excellent condition and enhances resistance to progressive erosion and leaks.

NEED FOR CORRECTIVE MEASURES

Potential Hazards

Many lives could be lost and property extensively damaged or destroyed if a flood approaching the magnitude of the inflow design flood occurs before corrective action is taken at McKay Dam. Without corrective action, the dam embankment and spillway could fail, resulting in a disastrous flood downstream along McKay Creek and the Umatilla River below McKay Creek.

The dam embankment and spillway parapet would be overtopped under the inflow design flood conditions. Flow across the crest of the embankment would cause rapid erosion of the gravel fill, and the parapet and lining on the upstream face would be undercut, resulting in a rapid breaching of the embankment. Wave action in the spillway chute would overtop the walls and could erode the abutment and dam embankment adjacent to the walls. Erosion of the embankment would begin immediately after overtopping. In a matter of minutes after the dam parapet had been overtopped, erosion of the noncohesive embankment would create a breach in the dam extending to the reservoir floor.

With the resulting breach in the dam, the discharge would increase from 20,000 cubic feet per second to about 1,500,000 cubic feet per second in possibly less than 1 hour and would decrease to the inflow to the reservoir in about 2 hours. There would be some reduction in peak flow as the flood wave resulting from McKay Dam failure moved downstream and down the Umatilla River valley. A detailed channel routing of the dam failure flood was made for the reach of McKay Creek down to the confluence with the Umatilla River. The routing indicated that the peak flow would be reduced to 1,180,000 cubic feet per second near the mouth of McKay Creek.

A routing study of lesser detail indicates that, while the flood crest would be significantly reduced down the Umatilla River valley, the peak flow reaching the Columbia River would be extremely large. The routing study estimated a peak flow of about 560,000 cubic feet per second reaching the Columbia River.

This study does not include any downstream effects below Echo, Oregon, in the economic analysis. It is obvious that there would be damages and a potential for loss of life below Echo from McKay Dam failure. The Corps of Engineers, which provided information on flood damages and estimates of loss of life figures, indicated that considerable additional data and detailed studies would be required to evaluate the flood effects below Echo. While the additional information would result in higher benefits in the economic analysis and would probably show a higher potential for loss of life, the conclusion would not change. Therefore, collecting additional data and conducting more studies were not considered necessary or justified.

Presently Endangered People and Property

The flood resulting from dam failure would pass through areas ranging from highly developed urban areas to agricultural and grazing lands. The flood would pass through settled areas of the Montee addition of Pendleton, Rieth, and Echo, Oregon, and farm lands totaling more than 4,000 acres. Residences for over 1,100 people, commercial developments, public facilities, roads, railroad tracks, bridges, and other improvements are in the area which would be inundated.

The major threat to life and property would be in the area along McKay Creek immediately below McKay Dam. The inundated area in this reach of McKay Creek is indicated on plate 10. The flood plain immediately below the dam changes rapidly from small farms to the highly developed urban area (Montee addition) close to Pendleton. As a result of the effective regulation of annual flood peaks on McKay Creek by McKay Reservoir, the flood plain in this area has developed on the basis of a low-flow regime. The magnitude of the development in this area is indicated in the photograph on plate 11. This area is developing at a rate faster than the rest of the region. The golf course is in this area and is a factor in attracting a high quality of residential development. About 270 homes and the golf course, including the club house, would be flooded. Other major developments in the flood plain include a bowling alley, Pendleton's sewage treatment plant at the mouth of McKay Creek, U.S. Highway 395, and numerous roads and bridges.

Along the Umatilla River, in addition to about 3,500 acres of agricultural land, the flood would affect the towns of Rieth and Echo, many farmsteads, and several commercial developments. About 152 homes and the stores, churches, and schools at Echo would be flooded. A sawmill, two grain elevators, a camper-trailer manufacturing plant, a seed mixing-processing facility, portions of the main line of the Union Pacific Railroad, the Pendleton-Echo highway, and other service roads would be damaged by the flood.

With failure of McKay Dam, damage to downstream property, to the regional economy, and to McKay Dam itself would far exceed the cost of the proposed corrective measures. Until replacement storage could be provided, the existing irrigation, fish and wildlife, and recreation activities dependent upon this reservoir would suffer serious losses.

Additional information regarding the potential losses in human life, reservoir benefits, and property is provided in the section "Expected Benefits."

Responsibility of Federal Government

Inasmuch as McKay Dam was designed and constructed and is presently operated and maintained by the Bureau of Reclamation, the Federal Government has the responsibility for surveillance of the dam and for initiating action necessary for its safety.

CORRECTIVE MEASURES CONSIDERED

The basic types of corrective measures considered in the study of alternatives include: (1) revision of reservoir operating procedures, (2) structural modification of the dam, (3) construction of upstream dams to reduce inflow design flood at McKay Dam, and (4) reduction of reservoir utilization with replacement water for the lost storage.

No plan of modifying operational procedures at McKay Reservoir could be identified which would insure safety of the dam and maintain the existing water supply yield. With the present outlet and spillway capacities and with reduced design standards, a storage space reservation of 36,000 acre-feet would be required until the flood threat passes. Any less storage space reservation could cause the structure to fail. Maintaining this space vacant would drastically reduce the water supply yield of the reservoir since nearly one-half of its active space would be held empty during the period of storable flows condition. In most years there would be little if any storable runoff after the flood threat passes.

Active capacity of the reservoir reduced to 37,800 acre-feet would yield about 37,300 acre-feet for irrigation purposes. The loss of storage water would adversely affect the financial structure of irrigators receiving water from McKay Reservoir. Reduction of the reservoir capacity would essentially eliminate fish benefits.

The structural modifications proposed and alternative designs considered are described later under the heading "Proposed Structural Modifications."

A possible upstream storage site at which storage could either reduce the inflow design flood at McKay Dam or provide replacement storage for McKay Reservoir was identified on McKay Creek about 8 miles upstream from the existing McKay Dam. This site, known as the Upper McKay damsite, was one of many considered in the Umatilla Basin Project feasibility investigation. The site was not used in the proposed plan of development for the April 1970 Umatilla Basin Project feasibility report. The Corps of Engineers also discussed this site in its 1965 McKay Creek Survey report.

A 36,000 acre-foot reservoir would be required at the Upper McKay site to reduce the inflow design flood to a safe level at McKay Dam. This alternative would cost about \$19,800,000.

Another alternative using the Upper McKay site to completely replace McKay Reservoir water supply was considered. In this alternative a dam with a reservoir capacity of 79,000 acre-feet would be required at the Upper McKay site and McKay Dam would be removed. The

construction cost of this alternative including breaching McKay Dam would be \$32,100,000.

In addition to cost consideration the Upper McKay site was rejected because of adverse environmental impacts. The major impacts would be the loss of agricultural land and wildlife habitat areas and the visual effect of the dam. Another negative aspect is the fact that the damsite is located within the boundaries of the Umatilla Indian Reservation.

Several plans were identified of reducing McKay Reservoir utilization and providing replacement water for the storage yield lost. In these plans the conservation storage capacity in McKay Reservoir would be reduced to 37,800 acre-feet, leaving a storage reservation of 36,000 acre-feet to insure the safety of McKay Dam. The water supply lost would be replaced by storage elsewhere in the Umatilla River system or by importing water from the Columbia River.

Replacement storage sites on streams other than McKay Creek were located and cost estimates prepared on several of the sites. Two of the sites are discussed in this report. One site is the Ryan damsite on the Umatilla River and the other is Meacham Creek damsite on Meacham Creek. These sites are shown on the vicinity map (see plate 1). The Ryan site was included as a key feature in the feasibility report on Umatilla Basin Project.

A 15,000 acre-foot reservoir would be required at either Ryan or Meacham Creek damsites to replace the water supply lost by reducing usable storage space in McKay Reservoir to 37,800 acre-feet. The construction cost of the dam and reservoir would be \$27,600,000 at the Ryan site and \$22,100,000 at the Meacham Creek site.

The Ryan site was dropped from further consideration because of the higher cost.

The Meacham Creek site was rejected from an economic comparison and because extreme adverse ecological and environmental impacts would be associated with this alternative. The reservoir area would inundate an essential critical habitat area utilized by elk during the winter.

The Meacham Creek drainage is the Umatilla River basin's most valuable anadromous fish spawning stream. The dam would block movement of the anadromous fishery resource.

One of the more promising alternative plans for replacing the storage yield lost from reducing 36,000 acre-feet active space in McKay Reservoir is a plan involving pumping from the Columbia River. A pumping plant on the south bank about 9 miles upstream from McNary Dam would lift about 15,000 acre-feet of replacement water over 300 feet to a 5-mile-long canal. The canal would convey the water to Cold Springs

Reservoir. The water would be lifted from the reservoir by a relift pumping plant near the end of the Feed Canal to the Stanfield Irrigation District distribution facilities. Some exchange could be made between Hermiston Irrigation District and the Westland and Stanfield Irrigation Districts which would reduce the relift pumping requirement. However, this study does not consider any reduction of relift pumping requirement in determining costs. It was assumed no space would be available in Cold Springs Reservoir for storage. The Columbia River and relift pumping plants would pump at a fairly constant rate with peak requirements being met by the remaining active storage in McKay Reservoir. The pumping plants would have capacity to pump the 15,000 acre-feet in 4 months. Including wear and operational losses, the design capacity would be 165 cubic feet per second. The construction cost of this alternative was estimated at \$5,480,000. The annual cost of operation, maintenance, replacements, and power is estimated at \$50,000.

The Columbia River pumping alternative was not selected as the proposed plan primarily because of the higher construction cost and adding annual costs (due to pumping) to the water users obligations. The alternative would have the least adverse environmental impact of the nonselected alternatives. The plan would have some beneficial aspects related to a stabilizing effect on Cold Springs Reservoir.

In the recent investigation of the Umatilla Basin Project, alternative plans were considered for the multiple purposes of flood control, dam safety, fish and wildlife, municipal and industrial water, and irrigation at McKay. The plans considered enlargement of McKay Dam and an exchange plan. The exchange plan was more favorable from a cost basis and was included in the project plan. In the exchange plan 20,000 acre-feet of the present storage space in McKay Reservoir would be reassigned to serve as flood control space and conservation space for fish and wildlife and recreation purposes. One-half or 10,000 acre-feet would be exclusively for flood control and the other 10,000 acre-feet would provide a minimum pool for fish and wildlife. The proposed Beacon reservoir on Tutuilla Creek would be constructed to include 20,000 acre-feet of irrigation water to replace the 20,000 acre-feet of reassigned space in McKay. The investigation concluded that the spillway at McKay Dam would require enlargement for dam safety and there was no advantage to delaying it until the Umatilla Basin Project could be constructed.

From the above described alternatives, the dam safety plans warranting evaluation and comparison are (1) structural modification at McKay Dam, (2) construction of an upstream flood storage reservoir, (3) construction of replacement storage reservoir on Meacham Creek, and (4) replacement pumping from the Columbia River.

COMPARISON OF ALTERNATIVES

The proposed structural modification work at McKay Dam would cost substantially less than the alternative plans which would accomplish the same objectives--that of correcting the existing unsafe situation at the dam.

The first alternative would involve construction of a dam upstream from McKay which would provide detention of the inflow design flood. The second alternative would involve reducing the active capacity at McKay Reservoir and construction of a new dam on Meacham Creek to develop a replacement water supply. The third alternative would involve reducing the active capacity in McKay Reservoir and construction of a pumping plant on the Columbia River and a carriage canal for replacement of the lost water supply.

The cost advantage of the proposed plan over the alternatives, based upon October 1974 prices, is shown on the tabulation on the following page.

The benefit-cost ratios of the alternative plans considered are compared in the section on "Expected Benefits."

COMPARISON OF ALTERNATIVES

	Proposed Plan	Alternative Plans		
	Structural Modification at McKay Dam (dollars)	Construction of Upstream Flood Reservoir (dollars)	Construction of Replacement Storage At Meacham Creek (dollars)	Replacement Pumping from Columbia River (dollars)
Construction costs ^{1/}	1,160,000	19,800,000	22,100,000	5,480,000
Interest during construction ^{2/}	68,000	2,326,000	2,597,000	483,000
TOTAL INVESTMENT COST	1,228,000	22,126,000	24,697,000	5,963,000
Annual equivalent ^{3/} investment costs ^{3/}	72,000	1,304,000	1,456,000	352,000
Annual O,M,R,&P (incremental)	--	8,000	12,000	50,000
TOTAL ANNUAL COSTS	72,000	1,312,000	1,468,000	402,000

^{1/} October 1974 prices.^{2/} Interest rate 5-7/8 percent; construction period 2 years proposed plan, 4 years for reservoir plans, and 3 years pumping plan.^{3/} Interest rate 5-7/8 percent and 100 years.

PROPOSED STRUCTURAL MODIFICATION

General

The purpose of the proposed structural modification is to provide sufficient capacity at McKay Dam and Reservoir to pass the updated inflow design flood with adequate dam safety. This could be accomplished without affecting water supply benefits and incidental flood control, fish and wildlife, and recreation benefits.

Studies have indicated that storage capacity in excess of that originally provided is not justifiable for any purpose; therefore, the proposal is to maintain the same reservoir capacity.

There is evidence of a need, along with the structural modification for safety purposes, to consider a change in the reservoir space allocation to recognize flood control, fish and wildlife, and recreation benefits presently being derived at McKay Reservoir. Information indicates that some of the presently unobligated reservoir space could be reallocated to these functions. Additional information on reallocation is discussed under the "Reallocation" section.

Proposed Design

The proposed modifications at McKay Dam would increase the capacity of the existing spillway from 10,000 to 27,000 cubic feet per second. This would be accomplished by modifying the spillway gate structure and increasing the width of the spillway chute using less than new dam design standards. This reduction in standards is acceptable considering the infrequent and short-term use of the freeboard and rock channel. The proposed modifications, shown on Drawing No. 30-D-130, plate 8, consist of the following actions:

1. Widening the spillway chute to increase its hydraulic capacity. The chute bottom width will be increased from 16 feet to 45 feet in the vicinity of the spillway gate structure. As the chute slopes down to river level the chute width is uniformly reduced to a minimum of 30 feet at the downstream end. Additional concrete lining is provided only on the widened floor of the chute as the rock walls are considered adequate for infrequent use.
2. Raising and extending an existing wall at the right abutment of the spillway gate structure to prevent overtopping of the wall.
3. Relocating the spillway gate hoists to allow the gates to be opened an additional 3 feet vertically. The increased gate opening is needed to permit passage of larger discharges through the spillway. Stops will be added to limit the gate openings.

With the proposed modifications and assuming an initial water surface elevation of 1322, the inflow design flood, when routed through the reservoir, would result in a surcharge of 9,750 acre-feet and a maximum water surface elevation of 1329.5. This would result in a freeboard of 0.5 feet to the crest of the dam and 3.0 feet to the top of the parapet. This new design freeboard would be 7.5 feet less than the design freeboard when the dam was constructed. At water surface elevation 1329.5, the maximum reservoir release would be 28,500 cubic feet per second, which consists of 1,500 cubic feet per second discharge through the outlet works, siphon spillway discharge of 680 cubic feet per second, and 26,320 cubic feet per second discharge through the gated spillway. The hydrographs of the inflow design flood and its routing through the reservoir are included on plate 9.

The cost of the proposed modifications at McKay Dam, based upon October 1974 prices, is estimated at \$1,160,000.

Alternative Designs

Alternative designs which would accomplish the same objective as the proposed design were studied and found to have disadvantages and higher costs compared to the proposed design.

An alternative spillway modification which would pass the inflow design flood with a more conservative freeboard was studied. This plan would require an increase in spillway capacity to 29,000 cubic feet per second. The modification included enlarging the gate structure and increasing the width of the chute and used more conservative standards of design. With this proposal and assuming an initial water surface elevation of 1322 the inflow design flood when routed through the reservoir would result in a freeboard of 3.8 feet on the dam exclusive of the 2.5-foot high parapet. The estimated total cost of this plan is \$2,500,000 at October 1974 prices.

Two alternative designs, both involving raising the dam to provide adequate flood storage and freeboard to handle the design flood, were considered. In addition to the enlargement of the embankment, the plans would require modification of the outlet works and gate structures. The cost of these alternative designs would be substantially more than the proposed design. Plans including these designs would have derived some additional flood control benefits; however, not enough to justify the additional cost. Also, the reservoir is part of the McKay National Wildlife Refuge and inundation of additional lands would result in adverse effect on the Refuge.

EXPECTED BENEFITS

Preservation and Protection of Life and Property

Benefits associated with the proposed modification of McKay Dam have been measured in terms of loss of human life and economic losses which would result from dam failure. The general extent to which human life and property would be subjected to the flood resulting from failure of the dam was briefly indicated under the section "Need for Corrective Measures."

It is not possible to accurately estimate the number of human lives that could be lost or otherwise seriously affected. There are about 270 homes housing an estimated population of 735 people who would be extremely vulnerable to the flood. Most of these are situated in the urban developed area between McKay Dam and the Umatilla River, a distance of only 5 miles. Plate 10 shows the inundated area in the critical reach of the flood plain below McKay Dam. The photograph on plate 11 shows the area immediately below McKay Dam. The type of storm leading to an inflow design flood is likely to occur with little leadtime for much advance warning. Significant factors in evacuating the flood plain would be the effectiveness of prompt action and communications and the time of day at dam failure. It is estimated that between 200 and 400 lives would be lost in this area in event of sudden dam failure. It has been assumed that the town of Echo and most of the downstream residents along the Umatilla River would be evacuated before the flood reached them. It would probably be impossible to warn everyone in the flood path, particularly the persons living in isolated locations and those traveling through the area. The potential for loss of life cannot be overemphasized.

While the spillway modification would not prevent damaging flows downstream from the dam during an inflow design flood, the modification would insure against the catastrophic flood from dam failure. The maximum flow (28,500 cubic feet per second) discharged from the reservoir during the inflow design flood would still be far larger than any flood of record. Releases would increase gradually, allowing time for warning and evacuation. Compared to dam failure, the potential for loss of life would be greatly reduced. Reduction of jeopardy to human life would be the most important benefit attributable to the proposed corrective work at McKay Dam, and this alone justifies prompt remedial measures. Economic costs associated with failure of the structure have been evaluated and further demonstrate justification for the proposed spillway enlargement.

Economic Aspects

The total economic loss that would result from failure of McKay Dam under the inflow design flood, estimated to be \$12,291,000, is summarized below:

Flood damage to property	\$6,537,000
Cost of reconstruction	
Construction	4,626,000
Interest during construction	<u>272,000</u>
	\$4,898,000
Benefits foregone during construction	
Irrigation	\$ 510,000
Recreation	72,000
Fish and wildlife enhancement	318,000
Less reservoir OM&R	<u>-44,000</u>
	\$ 856,000
 TOTAL ECONOMIC LOSSES IN EVENT OF FAILURE OF MCKAY DAM	 \$12,291,000

Flood damage to property below McKay Dam was estimated by the Corps of Engineers. Results of the studies were received by letter of May 30, 1974.

All property damage and reconstruction items of the estimate are in terms of total capital cost of commodities destroyed and cost of restoration work. Reservoir benefits lost during reconstruction are the irrigation, fish and wildlife, and recreation benefits now derived from the reservoir, less reservoir operation and maintenance costs between the time of failure of the dam and restoration of reservoir storage.

Flows larger than 1,000 cubic feet per second will cause overflows and flood damage along McKay Creek downstream from McKay Dam. During the inflow design flood and some lesser floods, spillway discharges will exceed this channel capacity. Significant flood damage could occur with the proposed plan as well as with any alternative design or plan. However, the average annual damage with the proposed plan would be substantially less than that which would occur without the reservoir. The current study indicates that provision of some exclusive flood control capacity in the reservoir to reduce downstream damage by the reallocation of McKay storage space could be justified.

Total Economic Benefits and Protection of Human Life

The total economic benefits to be derived from remedial measures for dam safety are the economic losses that would result from dam failure less the flood damages that would occur under inflow design flood conditions with the dam made safe. Under the proposed plan of an enlarged spillway and reservoir discharge of 28,500 cubic feet per second, the resulting damages from such an occurrence are estimated at \$4,218,000. In the alternative plans, damages of \$1,450,000 were estimated for floodflows through the existing facilities which have a capacity of about 11,400 cubic feet per second.

Because loss of human life is possible if McKay Dam is not made safe, and considering that continued storage of a water supply for the Umatilla Project is justified on the basis of benefits derived from that storage, the safety of the dam is assumed to be a requirement that must be met at all times and under all circumstances.

The inflow design flood could occur any year. Thus, economic justification is determined on the basis of benefits computed as though the structure were to fail at the beginning of the period analyzed. Accordingly, benefit values are not reduced because of the probabilistic nature of the possible catastrophe.

An analysis period of 100 years is used for economic justification of the corrective measures considered. Estimates indicate that sediment will not eliminate the usefulness of McKay Reservoir during that 100-year period of time.

Benefit-Cost Ratio

The benefit-cost ratio for each of the plans considered is derived as follows:

Item	Proposed Plan Structural Modification at McKay Dam (dollars)	Alternative Plans		
		Construction of Upstream Storage Reservoir (dollars)	Construction of Replacement Storage on Meacham Creek (dollars)	Replacement Pumping from Columbia River (dollars)
Total economic losses in event of failure of McKay Dam	12,291,000	12,291,000	12,291,000	12,291,000
Flood damage losses under safe dam condition	4,218,000	1,450,000	1,450,000	1,450,000
TOTAL ECONOMIC BENEFITS	8,073,000	10,841,000	10,841,000	10,841,000
Annual equivalent benefits ^{1/} ^{2/}	476,000	639,000	639,000	639,000
Annual equivalent costs ^{1/}	72,000	1,312,000	1,468,000	402,000
Benefit-cost ratio	6.6	0.5	0.4	1.6

^{1/} Interest rate of 5-7/8 percent and 100-year period of analysis. (factor .05895)

^{2/} Benefits reflect damage between McKay Dam and Echo only; damages below Echo not available. The benefit-cost ratio of 6.6 to 1.0 shows the proposed modifications at McKay Dam to be justifiable on the basis of economic-loss prevention. This economic justification is in addition to the justification of primary objective--that is, to prevent the loss of human life.

REALLOCATION AND REPAYMENT

Reallocation

Current active space (73,800 acre-feet) of McKay Reservoir is allocated to irrigation with 50,249 acre-feet under long-term contract, 11,395 acre-feet reserved from permanent disposition pending further determinations, and a residual space of 12,156 acre-feet. Irrigation entities have expressed a strong interest to use all of the space which is not under long-term contract. There is also strong local interest to modify the reservoir operations for more flood control.

McKay Dam was constructed specifically for irrigation; annual irrigation benefits, resulting from the use of water in the Stanfield and Westland Irrigation Districts and by individual contractors, are estimated at \$255,000. However, throughout the years other benefits have accrued from the reservoir operation such as flood control, recreation, and fish and wildlife. Property owners in the flood plain below the reservoir have requested protection from flood damages and have received some benefit through filling on a forecast basis. Since the residual space is not included under the existing contracts, it has been possible to operate the reservoir with some exclusive flood control space--beginning in 1960, the top 1,500 acre-feet which was subsequently increased to 3,000 acre-feet and in 1972 to 6,000 acre-feet. The 6,000 acre-feet of exclusive flood control space was selected as a compromise between flood control and water conservation. This space is sufficient to assure regulation of the maximum flood of record to bank-full capacity of the downstream channel without a major reduction in irrigation water supplies. In addition, this space has been used for flood control for several years without adverse effect upon the water users. The reservation of 6,000 acre-feet of space for exclusive flood control should be made permanent. A preliminary reconnaissance estimate indicates that the average annual flood control benefit for this operation would be about \$160,000.

Recreation benefits of \$36,000 annually were estimated by the Bureau of Outdoor Recreation by letter of September 18, 1974; fish and wildlife benefits of \$159,000 annually were estimated by the Fish and Wildlife Service by letter of November 21, 1974. These benefit estimates are based on the present system of operation which reflects using 6,000 acre-feet of space for flood control and the balance to meet the needs of irrigation. This same system of operation is assumed for the project in the future. The average annual minimum pool in the reservoir during the last 13 years under these conditions was about 9,000 acre-feet.

Based upon the foregoing, there appears to be good justification to reallocate McKay Reservoir costs to recognize the benefits accruing to flood control, recreation, and fish and wildlife. Since costs allocated to the foregoing purposes would be considered nonreimbursable, the

reallocation would have the effect of reassigning the costs of McKay Dam and Reservoir to nonreimbursable as well as reimbursable purposes. To illustrate the magnitude of this, a trial allocation was made of the original cost of McKay Dam and Reservoir (\$2,133,457 rounded to \$2,200,000) plus the existing shoreline facilities (\$12,000) plus the cost of the spillway modification (\$1,160,000). These costs were allocated proportionate to the benefits accruing to each purpose after deducting those costs which can be identified as incurred for a specific purpose--in this case, the \$12,000 for shoreline facilities. Benefits were evaluated on the basis of 6,000 acre-feet of reservoir space reserved exclusively for flood control use and the remaining 67,800 acre-feet of space for joint use. The results of this trial allocation are shown in the following tabulation.

McKay Dam
Trial Cost Allocation

Item	Irrigation	Flood Control	Recreation	Fish and Wildlife	Total
Justifiable expenditure ^{1/}	\$4,326,000	\$2,714,000	\$611,000	\$2,697,000	\$10,348,000
Specific costs	-	-	-	12,000	12,000
Remaining justifiable expenditure	\$4,326,000	\$2,714,000	\$611,000	\$2,686,000	\$10,336,000
Percent distribution	42	26	6	26	100
Remaining joint costs	\$1,405,000	\$884,000	\$198,000	\$873,000	\$3,360,000
Total allocated costs	\$1,405,000	\$884,000	\$198,000	\$885,000	\$3,372,000

^{1/} Benefits for each purpose adopted as its justifiable investment. Annual benefits converted to present worth values over 100 years at 5-7/8 percent (factor 16.96483).

In view of the benefits accruing to flood control, recreation, and fish and wildlife, it is recommended that McKay Dam and Reservoir be reauthorized to recognize these purposes. Additional studies will be made to refine benefits and costs for the purpose of the final cost allocation, and the costs will be allocated by the separable cost-remaining benefit method or another cost allocation method which may be determined appropriate.

Repayment

The Stanfield and Westland Irrigation Districts are the two major entities receiving water from McKay Dam and Reservoir. The first contract for water from McKay Dam and Reservoir was executed in 1923 with the Stanfield Irrigation District and with the Westland Irrigation District in 1925. Under these two contracts and subsequent amendatory contracts, the repayment obligation of the districts associated with the water supply was established at \$1,281,177. As the result of an investigation of economic conditions and repayment ability, Congress by the Act of October 27, 1949 (63 Stat. 942), authorized the Secretary of the Interior to execute amendatory contracts with the districts under section 7 of the Reclamation Project Act of 1939 (53 Stat. 1187). The amendatory repayment contracts of November 18, 1949, provided a long-term commitment for an equal sharing of 60 percent of the annual water supply stored in the reservoir for the Stanfield and Westland Irrigation Districts. In addition, the contracts provided that 25 percent of the annual supply would be reserved from permanent disposition by the United States pending determination of the terms and conditions under which such water would be available as a long-term commitment.

Subsequent to execution of the contracts and by mutual agreement with the districts, the reservoir has been operated on a holdover basis whereby each district is entitled to utilize 30 percent of the reservoir capacity; 22,140 acre-feet each or a total of 44,280 acre-feet. The 25 percent reservation was decreased to 15 percent: 11,070 acre-feet, with 3,690 acre-feet (5 percent) for Stanfield Irrigation District and 7,380 acre-feet (10 percent) for Westland Irrigation District.

The 1949 amendatory contracts established the water rate initially at \$0.25 per acre-foot diverted. The contracts provide for rate increases, if necessary, to pay annual reservoir operation and maintenance costs. The rate in 1974 was \$0.50 per acre-foot of which about \$0.45 was for operation and maintenance. As provided by the aforementioned Act, any revenues received in excess of the operation and maintenance costs are to be transferred to the Reclamation fund for project repayment. The reserved supply has been rented to the district at the same rate as the long-term commitment while up to 6,156 acre-feet of the residual supply of 12,156 acre-feet has been marketed at \$1 per acre-foot.

Contracts have also been executed with some 57 individuals providing for the long-term commitment of 5,969 acre-feet of the reservoir capacity. The obligations associated with this space were established on the basis of a \$30 per acre-foot rate repayable either in a lump sum or by annual installments over a period not to exceed 40 years. The individuals also pay annual operation and maintenance costs. Of the 57 individual contracts, 29 have fully paid their contractual obligation. In addition, two contracts have been executed with lumber companies to provide 325 acre-feet for millponds. These two contracts can be terminated by either party with 6 months' written notice.

The status of repayment as of June 30, 1974, appears below:

Total McKay Dam construction costs	\$2,133,457
Less: Payments through June 30, 1974	-328,381
Districts	(42,499) ^{1/}
Individuals	(94,471)
Water rentals and other revenues	<u>(191,411)</u>
Total outstanding costs	\$1,805,076
Less: Costs covered by existing contracts (individuals)	<u>-85,559</u>
Total unobligated costs	\$1,719,517

^{1/} The districts' repayment obligation under contracts prior to the Act of October 27, 1949, was \$1,281,177 of which \$42,499 had been repaid. The districts by the Act were relieved of the residual of \$1,238,678 which is included as unobligated costs.

The present operation of the reservoir to provide downstream flood protection has affected the quantity of stored water available for irrigation. Normally, direct flows in the Umatilla River provide an adequate irrigation water supply for the districts until about the end of June. In these years, the districts' contracted space, the reserved space, and the residual space are usually adequate to meet the water requirements. In years of low runoff, the districts have drawn on storage as early as April 15. These are the years when McKay Reservoir has not filled, and water supplies have been limited as early as mid-July.

The districts have expressed a desire to enter into long-term contracts for an additional 17,226 acre-feet of space: the presently reserved space of 11,070 acre-feet and the 6,156 acre-feet of the 12,156 acre-feet of residual space which they have been able to purchase in the past. This extra space would allow a carryover in good water years which would help the water supply situation to some degree in dry years. However, for all practical purposes, the districts have had the use of this capacity in the past.

The agricultural cropping pattern of hay and grain has been the result of the uncertainty of the water supply. If a firm water supply could be assured, it is possible that more intensive agricultural development could occur. Means of firming up the water supply could involve

additional storage, pumping from the Columbia River, or improvements in the districts' conveyance and distribution systems in which excessive water losses are now experienced. It is probable, however, that the increased payment capacity which could be realized by a firm water supply and a change in cropping would not meet all obligations incurred for such work.

The Bureau of Reclamation has also received, in previous years, numerous requests for long-term contracts. These have been deferred pending determination of water needs and the conditions under which the space would be marketed.

The following water marketing program is proposed to repay the newly recommended \$1,405,000 reimbursable irrigation construction cost allocation.

	Total to be paid over a 40-year period
Payments through June 30, 1974	
Districts	\$ 42,499
Individuals	94,471
Water rentals and other revenues	<u>191,411</u>
Subtotal through June 30, 1974	328,381 *
Capacity currently under long-term contracts	
Districts, 44,280 a-f @ about \$0.36/a-f (rnd) ^{1/}	633,850
Individuals, 5,969 a-f @ about \$0.75/a-f	<u>85,559 * ^{2/}</u>
Additional capacity to be marketed	
Capacity currently reserved from permanent disposition	
Districts, 11,070 a-f @ about \$0.36/a-f (rnd)	158,400
Individuals, 325 a-f @ \$1.50/a-f (30 years)	14,130 * ^{3/}
Residual capacity, 6,156 a-f @ \$0.75/a-f	<u>184,680 *</u>
Subtotal	\$1,076,619
Total for 67,800 acre-feet of capacity	<u>\$1,405,000</u>

^{1/} The \$0.75 per acre-foot rate to be charged for the 6,156 acre-feet of residual capacity is the rate presently being paid by the individuals with 5,969 acre-feet of reservoir capacity; the \$0.36 per acre-foot rate was computed by deducting from the irrigation cost allocation (\$1,405,000) the amounts in the tabulation indicated by * (\$612,750) and dividing the difference (\$792,250) by 55,350 acre-feet of capacity and by 40 years.

^{2/} Total value of contracts is \$180,030 of which \$94,471 has been repaid through June 30, 1974.

^{3/} Maximum value of contracts is \$19,500 of which \$5,362 has been repaid through June 30, 1974 (included in water rentals and other revenues).

In addition to the foregoing rates, the water users would pay 42 percent of the actual annual operation and maintenance costs of McKay Dam and Reservoir; this is the amount allocated to the irrigation function. The total operation and maintenance cost in 1975 has been estimated at \$31,500 of which 42 percent, or \$13,200, is allocated to irrigation. This amounts to about \$0.20 per acre-foot to be paid by the water users for the 67,800 acre-feet of capacity to be used for irrigation storage.

To determine if the water rate proposed for the districts is within their repayment ability, farm budgets were prepared for the district area. These budgets were based upon the costs presently being incurred by the districts and the present water supply which has been available for use. The representative farm budget shows that the farmers could: (1) pay all normal farm operating expenses, including the present water charge for district operating expenses, (2) pay the prevailing agricultural wages to the farm family for their labor, (3) allow a return to the farmer for his management, and (4) have a payment capacity of about \$3.18 per acre.

The following would be available to pay for water after allowing a 25 percent contingency:

	<u>Per Acre</u>	<u>Annual</u>
Payment capacity	\$3.18	
Available for water charge (75%)	2.40	\$35,515
Less: O&M (estimated 1975 applied to districts' proposed space of 55,350 acre-feet ^{1/})		<u>-11,070</u>
Subtotal		24,445
Less: Construction (applied to districts' proposed space of 55,350 acre-feet ^{1/})		<u>-19,806</u>
Total residual		\$ 4,639

^{1/} 44,280 acre-feet of space presently under long-term contracts and 11,070 acre-feet of space currently reserved from permanent disposition.

As shown above, the farmers in the district area have adequate payment capacity to pay the water rate associated with 55,350 acre-feet of reservoir space. Further, the present proposal is to first offer (at the rate of \$0.75 per acre-foot plus operation and maintenance

costs) the 6,156 acre-feet of residual space to individuals and entities who have in previous years requested water. Any uncontracted space could be made available to the districts. The districts have a residual payment capacity available to apply toward purchasing this space; and, if the cost is in excess of the residual payment capacity, the districts can utilize some of their 25 percent contingency.

The contractual arrangements will provide for the marketing of reservoir space at a specified rate to pay the construction cost over a 40-year period. The contracts will also provide for the payment of 42 percent of the actual annual operation and maintenance cost of the reservoir.

INTERIM OPERATING PROCEDURES

As a partial and temporary corrective measure for spillway and surcharge capacity deficiencies, reservoir flood season operating procedures were instituted for McKay Reservoir in 1972. Except for years when excessively heavy snowpack indicated the need for additional storage space, 12,100 acre-feet of space was reserved until March 1 for regulation of floodflows. This space reservation was reduced uniformly during March to 6,000 acre-feet by April 1 and was reserved exclusively for flood control during the balance of the year. Encroachments on flood control reservations were released at safe downstream channel capacity.

In 1974 the operating procedures were modified to provide storage reservation of 23,000 acre-feet until January 31. This would be reduced to 12,000 acre-feet by February 28. The reservation would be further reduced to 6,000 acre-feet by March 31. The 6,000 acre-feet would be held for exclusive flood control space, and should the high-level snowpack which produces storable runoff be such that storable inflows can be expected, additional storage capacity will be evacuated.

Water is stored in the 6,000 acre-feet of flood control space only as required to prevent flood damage downstream. Following such storage, reservoir releases are continued at or near bank-full capacity until the 6,000 acre-foot exclusive flood control space has been evacuated. The bank-full capacity of the channel downstream will vary from year to year, but about 1,000 cubic feet per second is considered full.

The plan of operation for future years will depend on when and if McKay Dam is modified. It is anticipated that even more restrictive space reservations will be required to reduce the risk of dam failure if modification of the dam is not completed within 2 or 3 years.

ENVIRONMENTAL IMPACTS

An assessment of potential environmental impacts was made as a part of the McKay Dam modification study. This chapter summarizes the major findings of the assessment.

The environmental impacts of the proposed action would be localized to the present spillway channel and the immediate dam area. The area adjacent to the discharge channel is presently used for dryland pasture, and the loss of less than 3 acres due to construction will have a minor impact on the present land use. The closest residence is located about 1,000 feet from the construction site. Noise and air pollution associated with construction would occur until completion and would be considered temporary adverse impacts.

The spillway enlargement would disrupt a nesting population of cliff swallows. The nesting areas along the present channel banks of the spillway would be lost through widening. The removal of swallow nesting areas will have a significant initial impact on present swallow populations. This initial impact will last until this population relocates in other areas, rebuilds nests on new banks, or are reduced in numbers. After the initial impact, effects of the project on the birds would generally level off.

The spillway enlargement would result in additional excavation of the natural landscape around the damsite. The magnitude of this increase will be small in comparison to the total area and the noticeability in the present surroundings will be slight.

Rock excavated to widen the spillway will be deposited on an existing berm along the downstream toe of the dam, and will blend into the existing structure.

Construction to enlarge McKay Dam spillway will not significantly affect fishery values and big game, upland game, and waterfowl populations. There are no known rare or endangered animal species in the area which would be affected.

Construction activities will have only very minor effects on recreation.

Air pollution control regulations for the State of Oregon and dust abatement practices will be put into effect to guard against unnecessary air pollution.

Measures will be taken to lessen the visual impact of the project. Side slopes of borrow pits will be brought to stable slopes and shaped to provide a natural appearance. Topsoil will be replaced on disturbed areas and reseeded with adaptable varieties of grasses. All rubbish,

contractor's equipment, and temporary structures will be removed from the site. All spoil banks from excavation that are not used for fill material will be designed to blend, to the extent practicable, with the natural topography of the area. Banks will be shaped to minimize erosion and seeded to adapted varieties of grasses. Upon completion of construction, all temporary access roads that may be needed for construction purposes will be severed from vehicular access, the area shaped to original condition, and seeded to adapted varieties of grasses.

Waste products (oil, diesel fuel, grease, solvents, etc.,) of servicing operations in these areas will be disposed of in a manner to avoid stream pollution. Contract requirements will include proper collection and disposal of waste products as well as the removal, upon completion of construction, of all equipment, supplies, buildings, and other personal property of the contractor.

Storage and handling of combustible materials and provisions for fire prevention will be accomplished in accordance with the Department of Labor "Safety and Health Regulations for Construction" and the Bureau of Reclamation supplement thereto.

The transportation, storage, and use of explosives required for rock excavation will be in accordance with the Department of Labor "Safety and Health Regulations for Construction" and the Bureau of Reclamation supplement.

The long-term environmental effect desired from modification of the McKay Dam spillway is the protection from possible catastrophic loss of human lives, public and private property, and disruption of the social, economic, environmental, and ecological balance in the area downstream from the dam. This long-term protection will have a continuing beneficial effect on the citizenry sense of well-being and the social and economic character of the affected area.

The existing McKay Dam spillway would not pass the inflow design floodflow without overtopping the dam. Water flowing over the dam would cause a breach to the dam foundation, and the resulting surge flow would cause catastrophic loss of life and property damage downstream from McKay Dam. It is estimated that between 200 and 400 human lives could be lost in this area in event of the envisioned sudden dam failure if no prior warning were received. There would also be economic losses to downstream property (railroads, highways, and other structures) resulting from this increased floodflow, production lost during a recovery period, and the cost of reconstructing the failed dam.

In addition to the environmental degradation of areas downstream from the dam following a catastrophic flood, the remainder of the 30,000 acres normally irrigated from McKay Reservoir would receive very little water during the 2-year period required for dam reconstruction.

Upland game on those areas probably would suffer a temporary setback. The loss of the reservoir would temporarily affect migratory waterfowl and upland game presently using the National Wildlife Refuge. The existing fishery and recreational benefits would be lost until such time as the dam could be rebuilt.

These long-term benefits would be obtained at the cost of the environmental impacts discussed above and commitment of man-hours and material expended during construction.

The National Register of Historic Places has been consulted and the property is not listed.

CONSTRUCTION SCHEDULE FOR PROPOSED PLAN

It is estimated that two construction seasons would be required for enlarging the spillway. Approximately 4 months would be required for obtaining additional field data. The preparation of design drawings and specifications for the prime contract should be started 6 months prior to the specifications issuance date. Construction can be accomplished without affecting operation of the reservoir. See plate 12 for cost estimates and plate 13 for PF-2.

An estimate of the funds required each year is as follows:

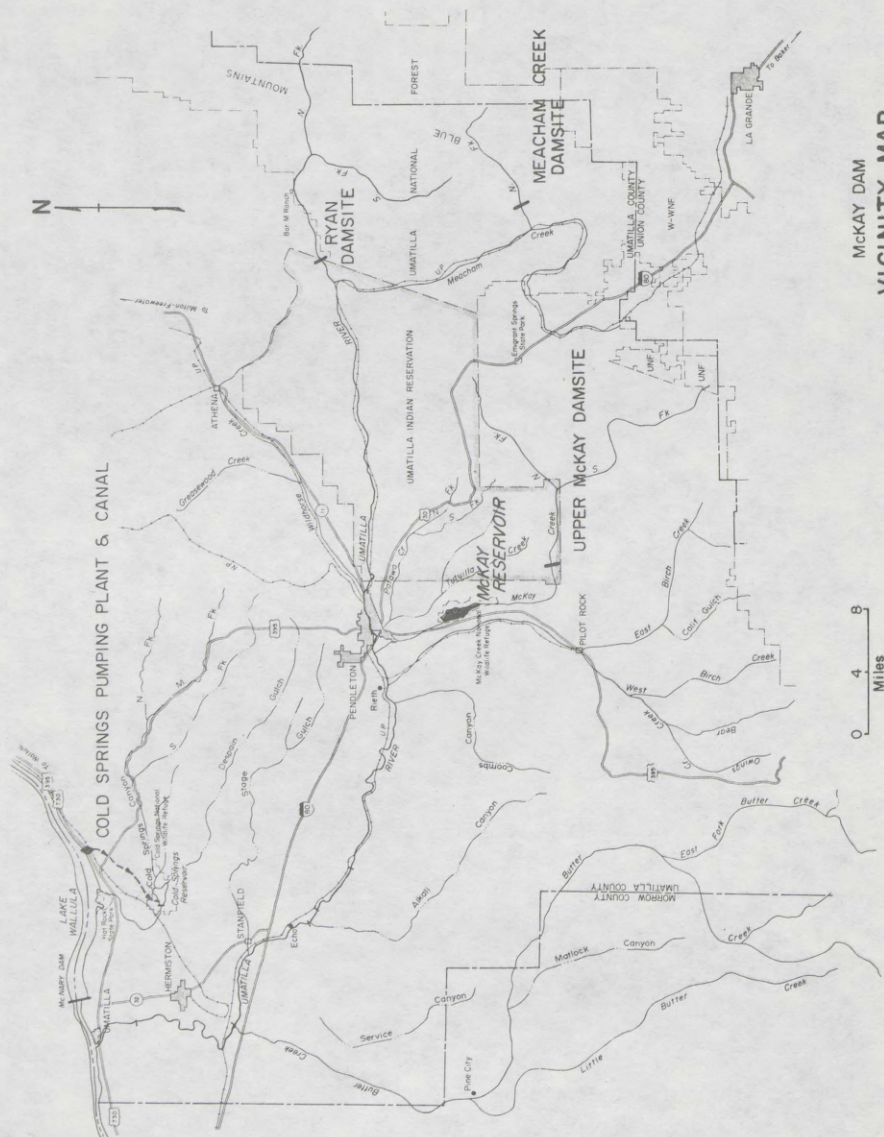
Construction	
First year (Preconstruction)	\$200,000
Second year	\$600,000
Third year	\$290,000

RECOMMENDATIONS

Based on the information in this report, it is recommended that:

- The existing spillway on McKay Dam be modified to accommodate the new inflow design flood.
- Space be allocated to irrigation and flood control with 6,000 acre-feet of exclusive flood control space.
- Authorization of funds for proposed modification be expedited.
- Final reallocation of costs to irrigation, flood control, recreation, and fish and wildlife be made through additional studies using the separable cost-remaining benefit method or another cost allocation method determined appropriate.
- Costs allocated to flood control, fish and wildlife, and recreation be nonreimbursable, and all costs allocated to irrigation be reimbursable.

Red Verrin



**McKAY DAM
VICINITY MAP**

Cold Springs Dam and Reservoir
Cold Springs Reservoir is located offstream about 6 miles northeast of Hermiston, Oregon, on the Columbia River. The reservoir is a sand earthenfill type with a structural height of 98 feet and a volume of 793,000 cubic yards. The reservoir active capacity is 50,000 acre-feet.

McKay Dam and Reservoir
McKay Dam on McKay Creek, about 6 miles south of Prineville, Oregon, is a concrete gravity dam with a structural height of 165 feet and a volume of 100,000 cubic yards. The reservoir has an active storage capacity of 23,800 acre-feet.

Feed Canal Diversion Dam and Canal
The dam is located on the Umatilla River 1½ miles southeast of Elsie, Oregon. It is a concrete, rock, and timber weir with an embankment wing, thus forming a 23-mile-long canal. The canal extends to the Cold Springs Reservoir. These structures provide water for offstream storage for late summer release from the dam. The capacity of the canal is 350 cubic feet per second.

Maxwell Diversion Dam and Canal
The Maxwell Diversion Dam and Canal divert water from the Umatilla River. The dam is a concrete and timber-crib weir with an embankment wing. It is about 1 mile west of Hinkle, Oregon. It permits diversion into the Maxwell Creek and Umatilla River. The canal is 10 miles long and has an initial capacity of 140 cubic feet per second.

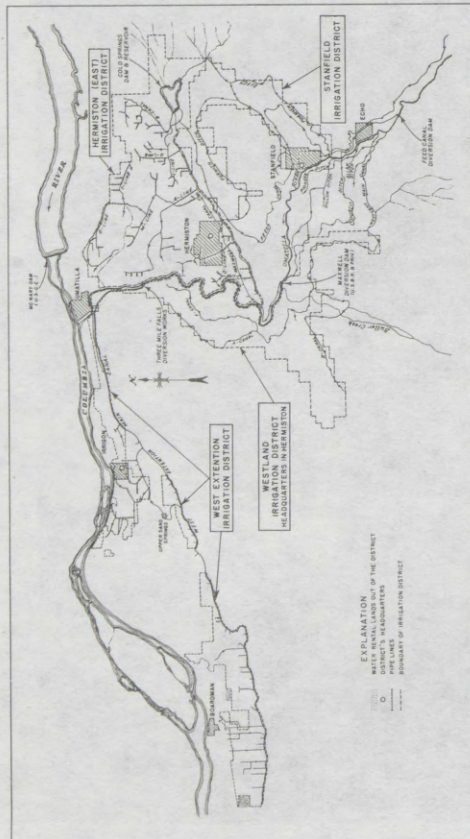
Three Mile Falls Diversion Dam and Canal
This concrete multiple arch weir diverts water to the West division of the project via the West Elevation Main Canal. The dam has a structural height of 74 feet and a hydraulic capacity of 1,280 cubic feet per second. The canal is 27 miles long and has a diversion capacity of 375 cubic feet per second. Water to irrigate about 7,000 acres is supplied through these works.

Facilities in Operation (June, 1965)

Storage Dam	2	Canal (miles)	123.800
Diversion Dam	3	Canal (miles)	60
Canal (miles)	14	Climate	14
Climate	8.2	Annual precipitation (inches)	109"
Annual precipitation (inches)	35"	Maximum	92.2"
Temperature	180-210	Growing season (days)	470
Maximum	180-210	Elevation of irrigable area (feet)	470
Growing season (days)	470	Principal Products	31,000 acres of land benefit from the irrigation facilities of the project. Principal crops are alfalfa, hay, grain, pasture, and truck.

Recreation
Cold Springs and McKay Reservoirs are in a national waterfowl refuge. The areas have limited use for picnicking, swimming, boating, fishing, and waterfowl hunting.

FOR INFORMATION:
U. S. BUREAU OF RECLAMATION
REGION 1, Box 937
Boise, Idaho
GPO 948-313



UMATILLA PROJECT -- FACTUAL DATA

Project features of the East division are Cold Springs Dam and Reservoir, an offstream reservoir; Feed Canal and McKay Diversion Dam on the Umatilla River; and the 27-mile West Elevation Main Canal are the principal features of the West division. McKay Dam and Reservoir are the only features in the South division.

The project plan provides for the irrigation of lands in the lower Umatilla River Valley and along the south side of the Columbia River westwardly from the town of Umatilla with water from the Umatilla River. Storage is provided by Cold Springs Reservoir. The project also includes a feed canal from the Umatilla River, and by McKay Dam on McKay Creek. Three diversion dams on the Umatilla River divert into three canals from the Umatilla River: the Maxwell, the Three Mile Falls, and the West Elevation Main Canal, each of which serve portions of the project lands.

Stanfield and Wetland Irrigation Districts have each consented for ownership of 10 percent of the storage space in McKay Reservoir. Storage water is released from McKay Reservoir on order from the districts. The Bureau has no further responsibility for the distribution of the stored water, as the districts operate their own canal systems.

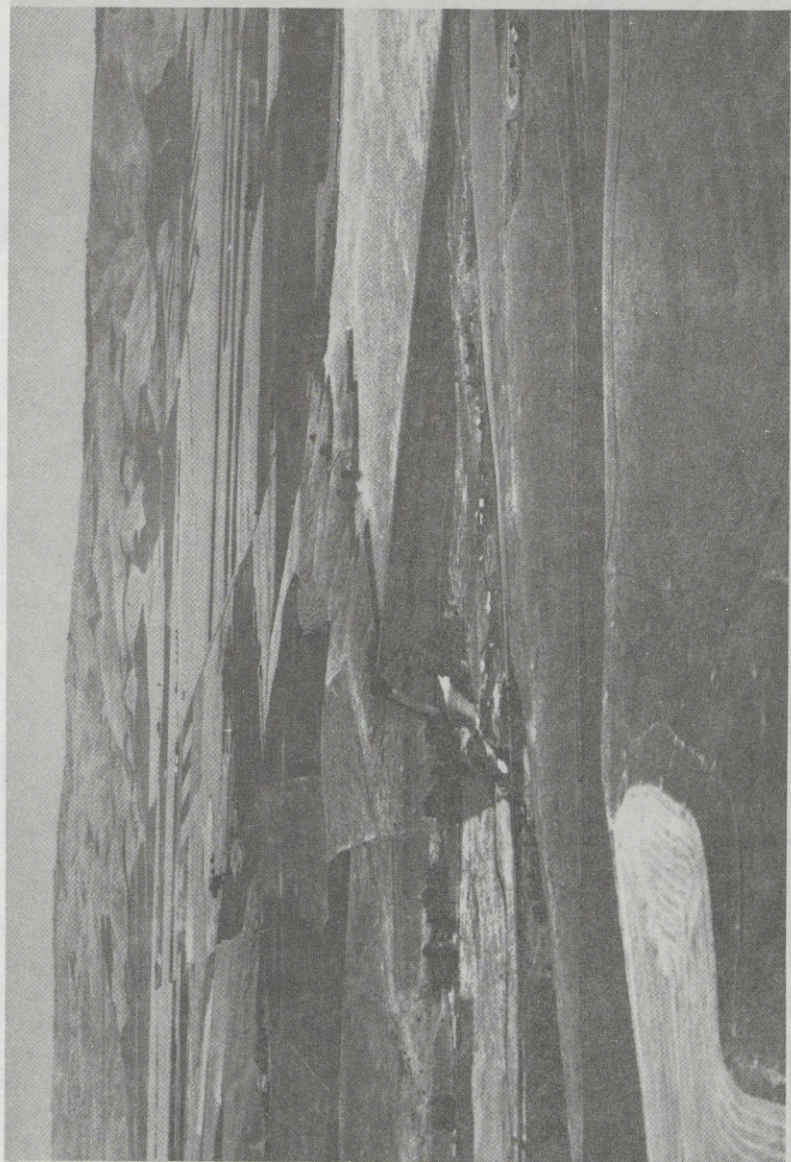
WATER SUPPLY

Umatilla River	Drainage area at Yankum, Oreg. (square miles)	1,280
Annual discharge (acre-feet):		
Maximum (1904)	815,000	
Minimum (1907)	235,000	
Average (50 years)	490,000	
McKay Creek	Drainage area at Pilot Rock, Oreg. (square miles)	178
Annual discharge (acre-feet):		
Maximum (1948)	136,400	
Minimum (1934)	38,000	
Average (25 years)	71,000	

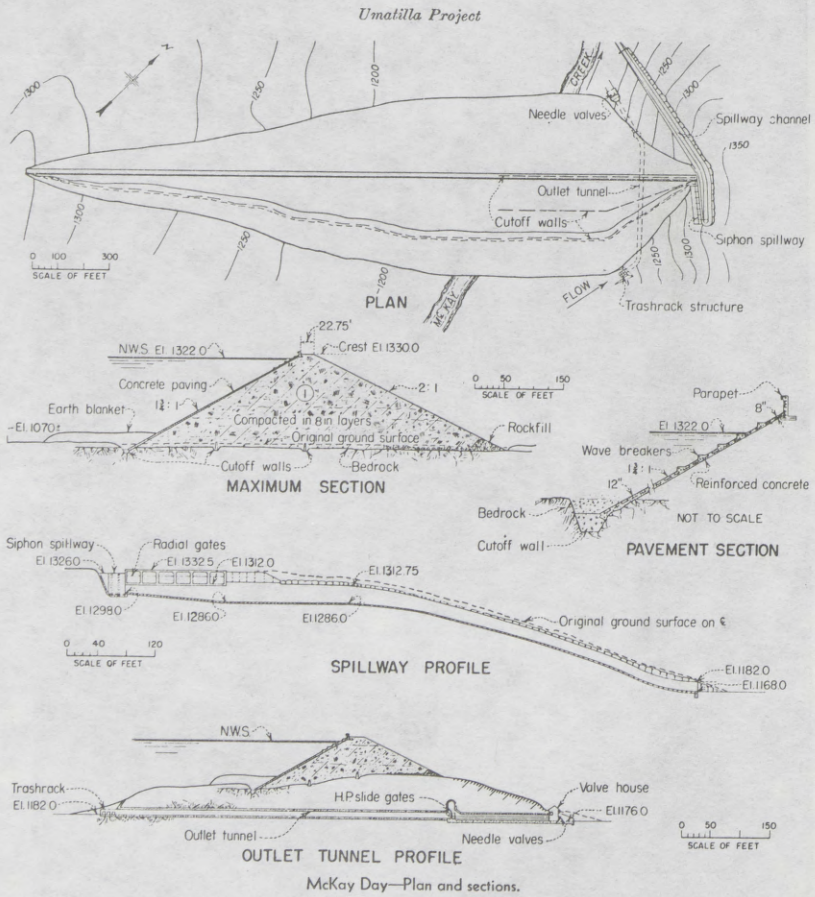
FEATURES OF THE PROJECT

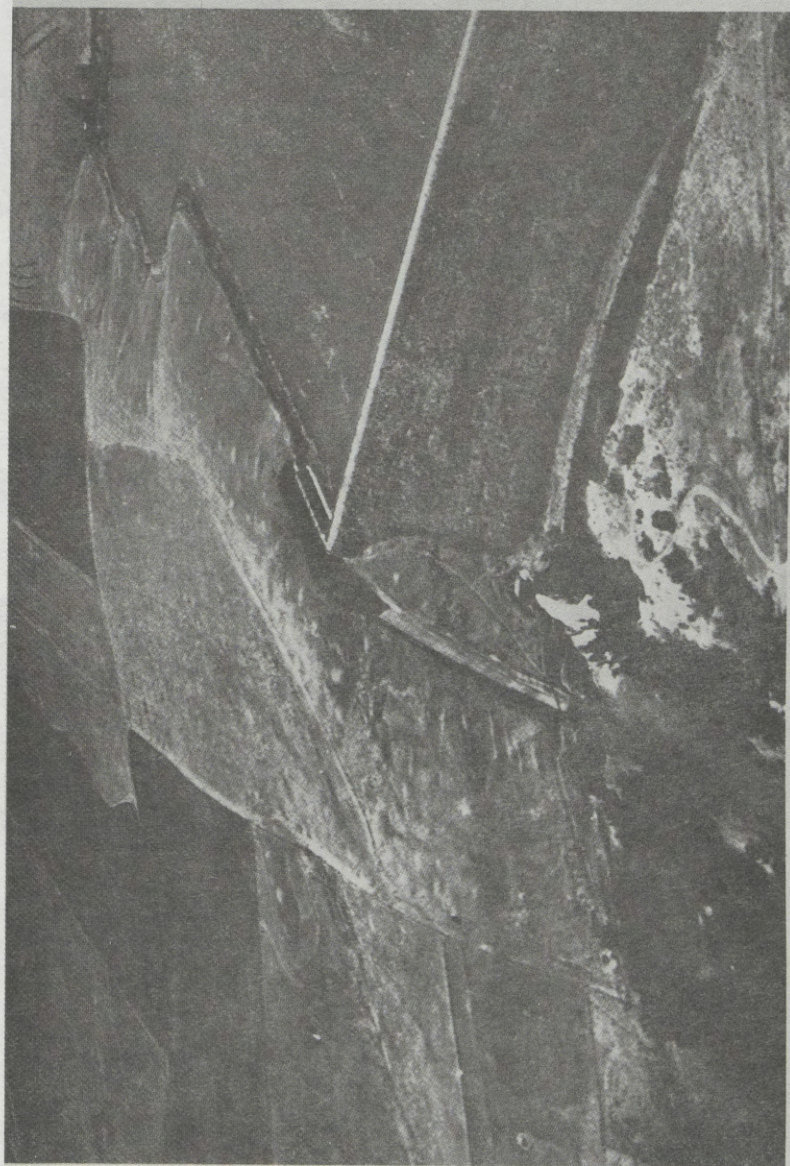
Umatilla project is equipped to furnish a full supply of irrigation water to about 18,000 acres and a supplemental supply almost a third more. The project is located in the Umatilla River Valley and is divided into three divisions. The East division is the Hermiston Irrigation District, and the South division includes the Stanfield and Wetland Irrigation Districts.



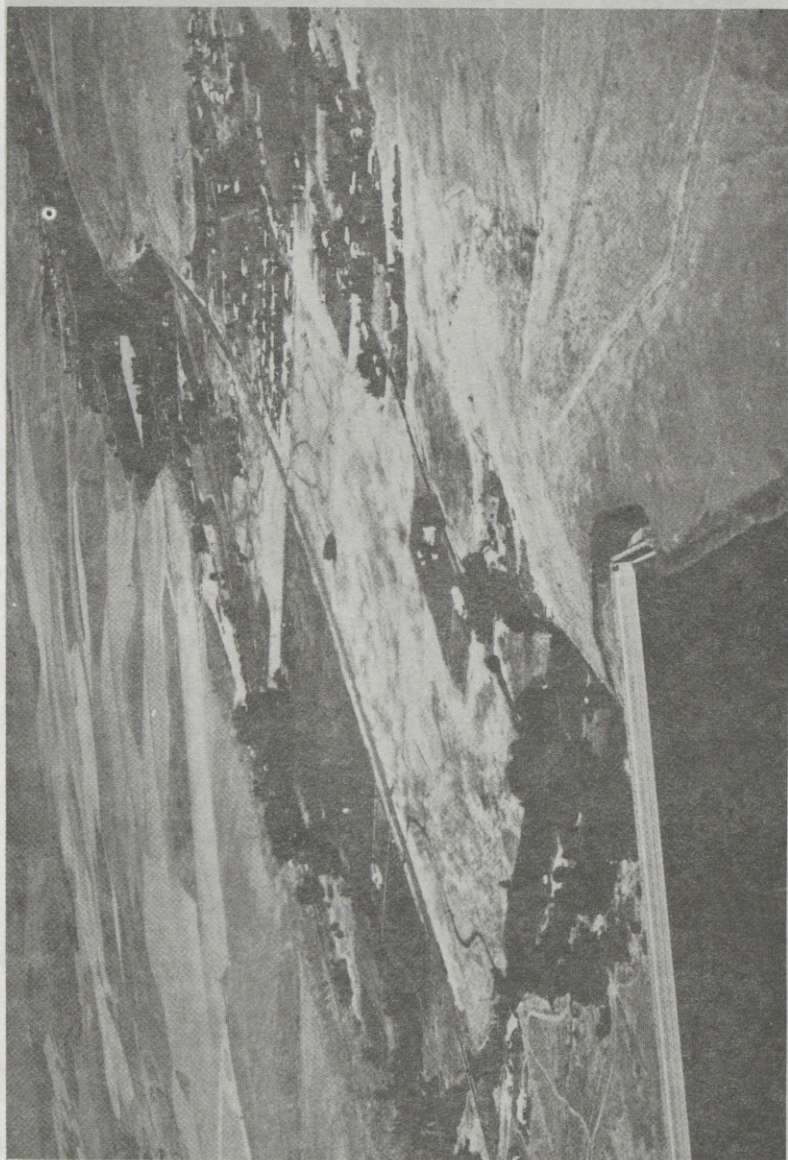


McKay Dam and Reservoir

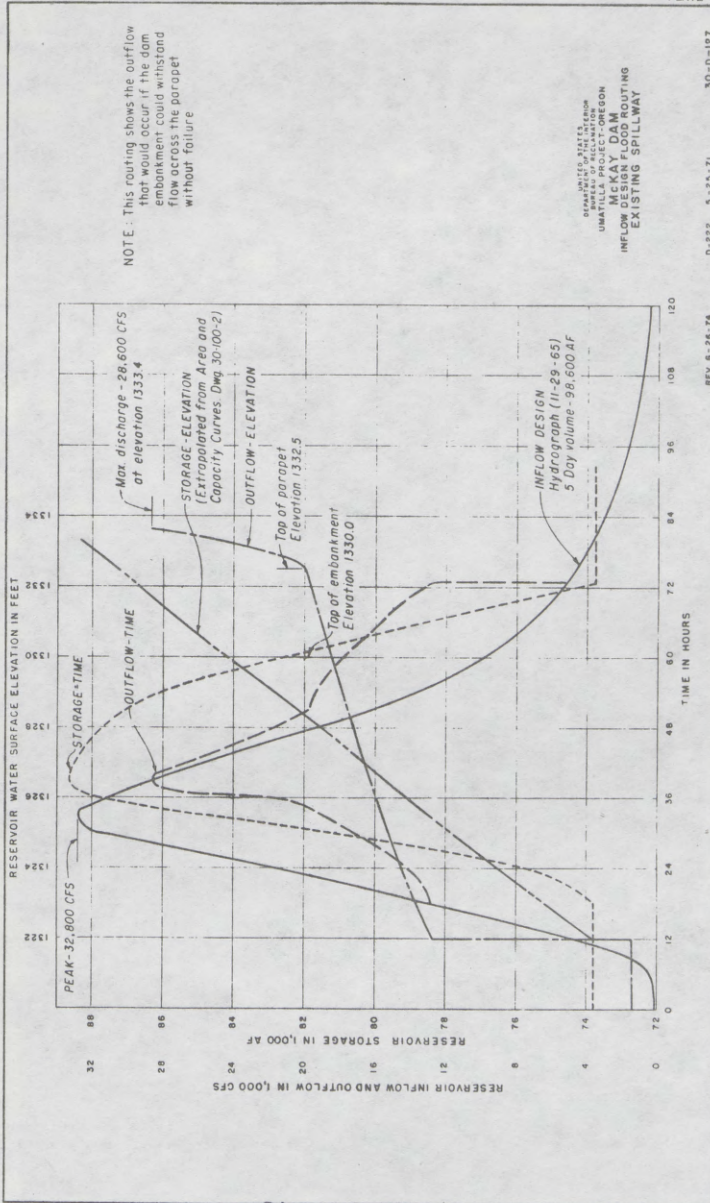


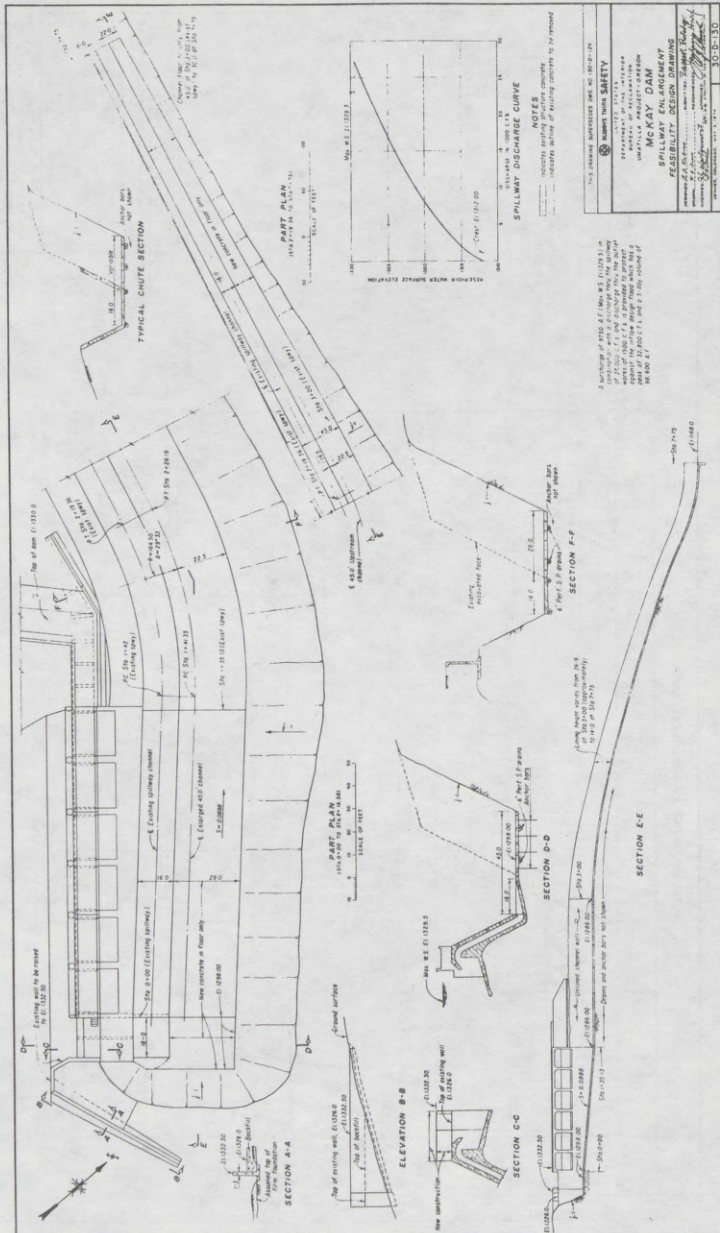


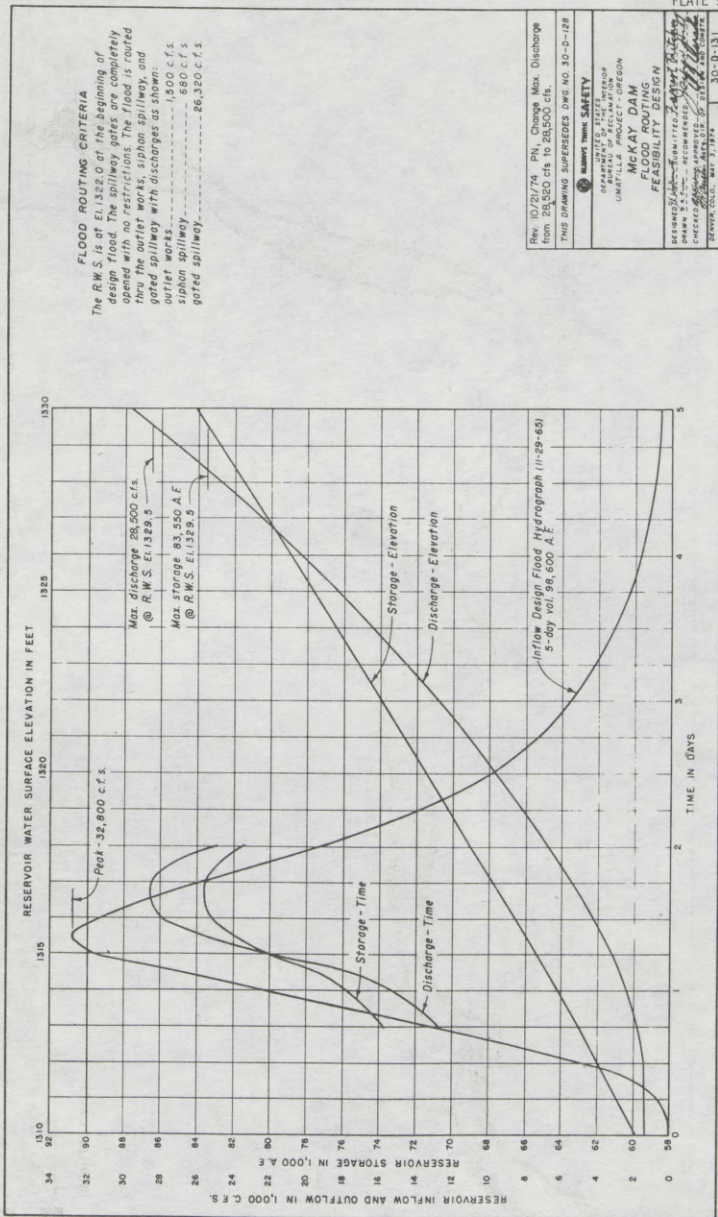
McKay Dam - Spillway and Outlet Works

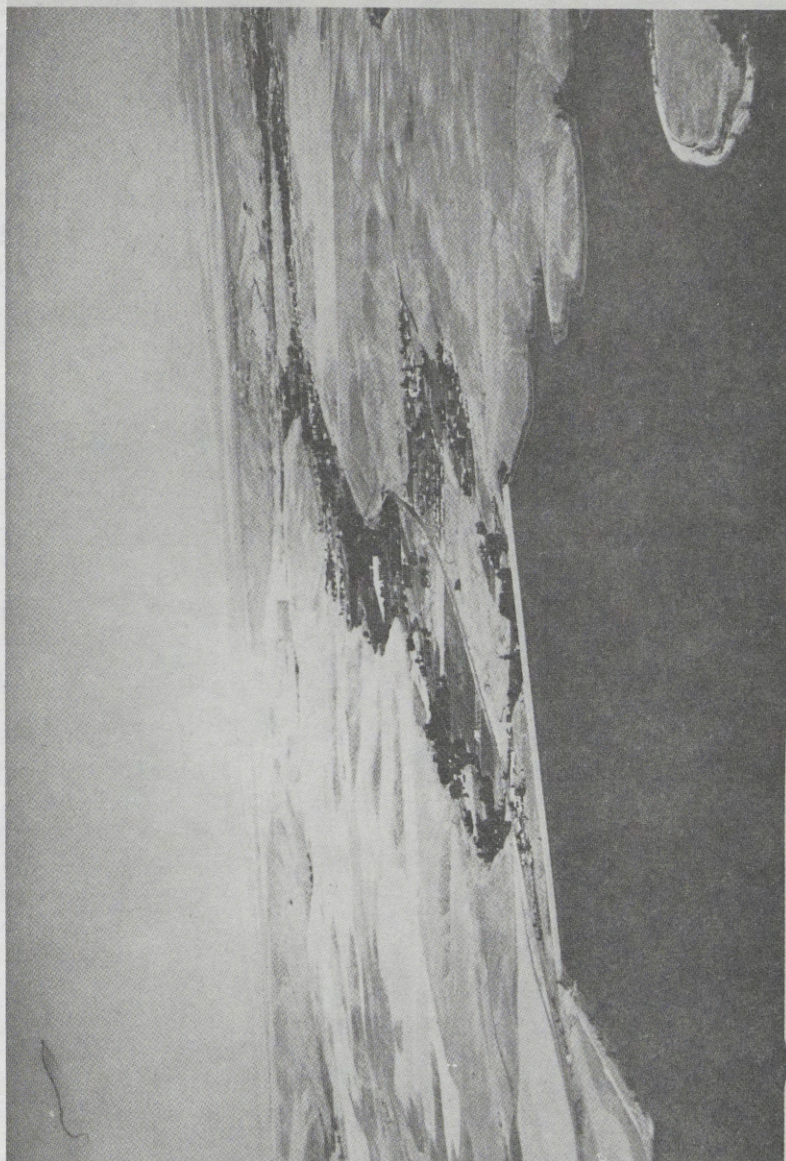


McKay Dam, Spillway and McKay Creek Flood Plain









Flood Plain Below McKay Reservoir

LEGEND: Types of Activity
 A Reconstruction
 B Other Work
 C Construction

LINE NO	PROGRAM ITEM	QUANTITY	ESTIMATED TOTAL	TOTAL TO TO JUNE 30, 1975	FISCAL YEARS												BALANCE TO COMPLETE	ON JAN 1
					Construction Year 5	Construction Year 6	Construction Year 7	Construction Year 8	Construction Year 9	Construction Year 10	Construction Year 11	Construction Year 12						
1	CONSTRUCTION PROGRAM	2	3	4														1
2																		2
3	McKay Dam --		1,160,000	65,000	200,000	600,000	295,000											3
4	Modify spillway to increase capacity from 10,000 cfs to 27,000 cfs																	4
5																		5
6	Total Construction Cost		1,160,000	65,000	200,000	600,000	295,000											6
7																		7
8	Total Project Cost		1,160,000	65,000	200,000	600,000	295,000											8
9																		9
10	Consolidated Expenditures and Credits		-70,000	-65,000			-5,000											10
11																		11
12	Total Expenditures		1,090,000		200,000	600,000	290,000											12
13																		13
14	Total Obligations		1,090,000		200,000	600,000	290,000											14
15																		15
16	Funds Required		1,090,000		200,000	600,000	290,000											16
17																		17
18																		18
19																		19
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21																		21
22																		22
23																		23
24																		24
25																		25
26																		26
27																		27

Notes: October 1974 price level.

RECOMMENDED: _____ (Sponsoring Office Head) _____ (Date)

RECOMMENDED: _____ (Regional Director) _____ (Date)

RECOMMENDED: _____ (Chief, Div. of P & F) _____ (Date)

APPROVED: _____ (Commissioner) _____ (Date)

REVISAL: _____ (Date)

SHEET 1 OF 1 SHEETS

UNITED STATES
 DEPARTMENT OF THE INTERIOR
 BUREAU OF RECLAMATION
 CONTROL SCHEDULE
 McKay Dam
 Modification of McKay Dam

Boise, Idaho OFFICE
 GENERAL INVESTIGATIONS
 CONSTRUCTION

DATE
 December 1974
 REGION
 McMAN PROGRAM
 BOISER

1. Name of the person or organization to whom the property is being donated.	2. Address of the person or organization to whom the property is being donated.	3. City and State of the person or organization to whom the property is being donated.	4. Description of the property being donated.	5. Date of the donation.	6. Signature of the donor.
7. Name of the person or organization to whom the property is being donated.	8. Address of the person or organization to whom the property is being donated.	9. City and State of the person or organization to whom the property is being donated.	10. Description of the property being donated.	11. Date of the donation.	12. Signature of the donor.
13. Name of the person or organization to whom the property is being donated.	14. Address of the person or organization to whom the property is being donated.	15. City and State of the person or organization to whom the property is being donated.	16. Description of the property being donated.	17. Date of the donation.	18. Signature of the donor.
19. Name of the person or organization to whom the property is being donated.	20. Address of the person or organization to whom the property is being donated.	21. City and State of the person or organization to whom the property is being donated.	22. Description of the property being donated.	23. Date of the donation.	24. Signature of the donor.
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