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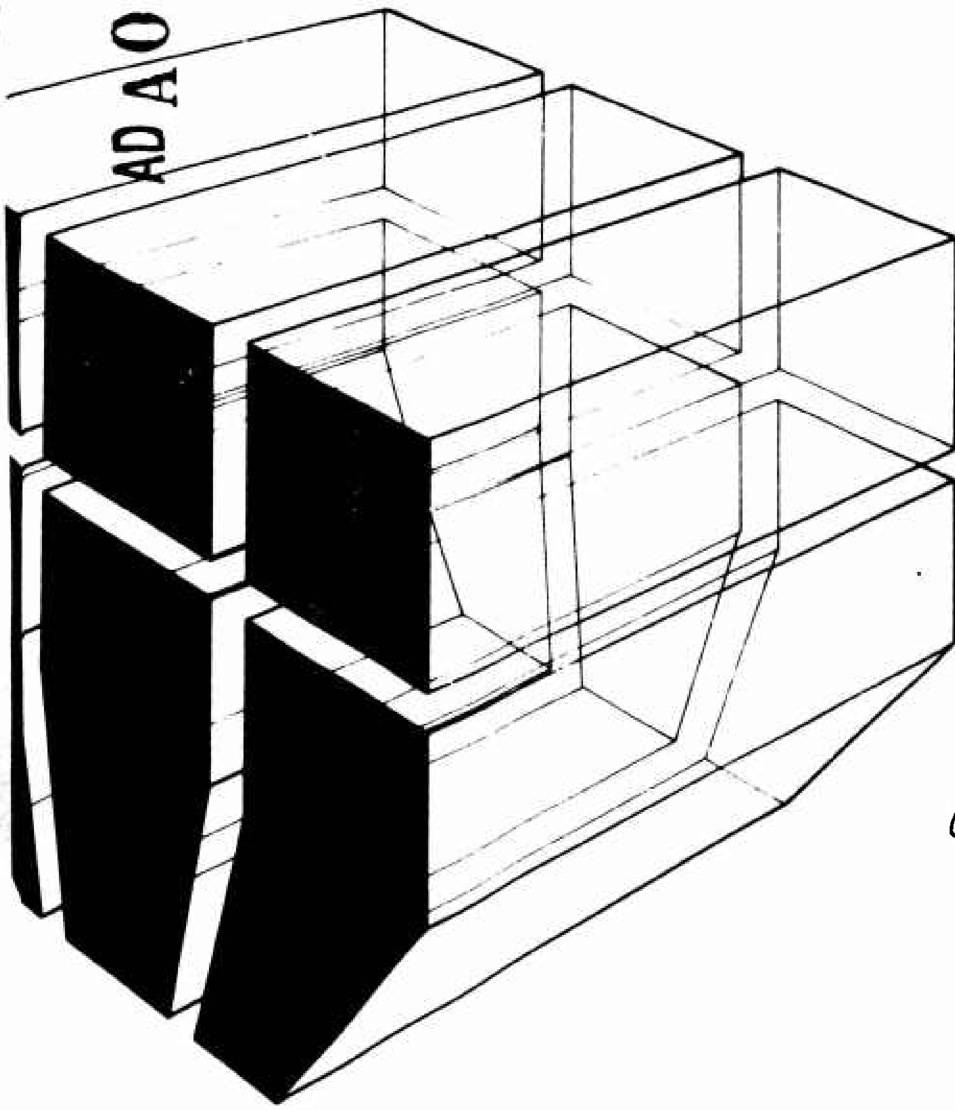
INTERIM REPORT E-77
April 1976
Disposal of Solid Waste from Reservoir Clearing and Cleaning

DISPOSAL OF CLEANING DEBRIS



by
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CERL

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Most project managers at Corps of Engineers (COE) impoundments dispose of cleaning debris by unconfined burning. However, environmental legislation and enforcement trends indicate that unconfined burning will soon be eliminated as a means to dispose of cleaning debris in many areas of the United States.

There are several methods to dispose of cleaning debris. These

alternatives include, but are not limited to:

1. placing the debris on the ground to decompose
2. burying the debris with or without processing
3. selling the debris without processing
4. processing the debris for sale as firewood, mulch, etc.
5. burning the debris by confined or unconfined burning techniques.

Eight sites were visited to collect site-specific data on a list of factors deemed to be essential in evaluating the disposal methods. Four site visits are described in detail while the remaining four are summarized. The study determined that each site must be considered individually, using social, economic, and physical factors to determine the most appropriate debris disposal method for the location. There is no universal debris removal or disposal method that can be used economically at all locations.

FOREWORD

The U. S. Army Construction Engineering Research Laboratory (CERL) conducted this study for the Directorate of Civil Works, Office of the Chief of Engineers, under Program Title (Level II) Environmental Impact, CWIS Work Unit 31055, "Disposal of Solid Wastes from Reservoir Clearing and Cleaning." The work was performed by CERL's Environmental Engineering Team, Environmental Division (EN). The OCE Technical Monitor is Mr. John B. Bushman; the Assistant Technical Monitor is Mr. John S. Robertson.

Personnel from the following Corps Districts and Divisions provided information for this report: Mobile District, South Atlantic Division; St. Louis District, Lower Mississippi Valley Division; Portland District, North Pacific Division; and New England Division. Their time and assistance were greatly appreciated.

Mr. W. J. Mikucki is Acting Leader of the Environmental Engineering Team, and Dr. R. K. Jain is Acting Chief of EN. COL M. D. Remus is Commander and Director of CERL, and Dr. L. R. Shaffer is Deputy Director.

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1 INTRODUCTION

Background

According to the results of a questionnaire sent to 415 reservoir managers, project engineers, resource managers, and lockmasters in the 10 continental divisions of the Corps of Engineers (COE), an estimated $1.8 million is spent annually on debris problems at COE impoundments: $1.4 million for removal operations and $0.4 million for disposal operations.

Traditionally, COE impoundments have been in remote locations, and project managers have selected the cheapest method for the disposal operation. Presently, however, many people use impoundments for recreational activities, and the population densities surrounding these once isolated areas have increased substantially.

Recent environmental laws have made the disposal of debris at impoundments a more difficult problem than the matter of economics it once was. The project manager must consider a number of complex and interacting factors in selecting an appropriate disposal method.

Objective

The objective of this four-phase study is to develop an overall management concept for disposal of solid waste from clearing and cleaning operations at Corps impoundments. The purpose of this report, which covers phase two of the study, is to provide planning and operational personnel with information needed to evaluate alternative methods of cleaning debris disposal.

Phase one of the overall study dealt with available equipment that could be used to dispose of debris at impoundments, particularly chipping equipment and equipment that could be used for pit incineration. During phase three, investigators will consider the factors and information necessary for selecting the best debris disposal method(s) for clearing debris. In phase four, researchers will summarize all the work done, emphasizing the management concepts and implications of pertinent state legislation concerning viable alternatives for debris disposal at impoundments.

Approach

Researchers prepared a list of essential factors (Figure 1) which must be evaluated in order to determine the most appropriate debris disposal method for a site.

A. Description of the dam, powerhouse, locks, etc.

1. Primary functions
2. Secondary functions
3. Water depth, rate of flow, etc.

B. Debris

1. Sources
   a. From natural occurrences
   b. From man-made occurrences

2. Characteristics
   a. Type of debris
   b. Quantity of debris
   c. Size of individual items of debris

3. Location
   a. Method of containing or trapping debris
   b. Method of debris removal
   c. Accessibility of debris
   d. Available equipment

C. Present disposal method - unconfined burning

1. Proximity of disposal sites to populated areas, highways, water bodies, etc.
2. Public response to disposal operation
3. Objections or problems associated with present operating procedures
4. Number of employees involved in removal and disposal operations
5. Frequency of removal and disposal operations
6. Accessibility to disposal site

D. General physical environment near the dam and in the watershed

1. Climate and extreme weather conditions
2. Type and depth of bedrock
3. Type and depth of soil
4. Area topography and local relief
5. Depth of water table
6. Amount of annual surface runoff
7. Low flow period of streams in the watershed

E. Safety of workers and visitors

1. Main tourist season
2. Possible hazards to visitors and workers

F. Environmental considerations

1. Present and potential problems with:
   a. Land and land-use compatibility
   b. Water, surface, and groundwater quality
   c. Air quality
   d. Noise, shock, and vibration

G. Legal considerations

1. Present and future conflicts with:
   a. Federal laws and regulating agencies
   b. State laws and regulating agencies
   c. Local laws and ordinances and regulating agencies
2. Necessary burning permits
3. Regulated seasonal burning

H. Economic considerations

1. Proximity to market or disposal area
2. Labor costs
3. Processing costs
4. Transportation costs
5. Comparison of market value of debris to total costs of processing, transporting, etc.
6. Market demands

Figure 1. Alternative evaluation outline.

Using the list of factors, investigators visited eight sites and attempted to determine whether

1. any unnecessary factors were included in the list

2. any essential factors were excluded from the list

3. cleaning debris at a site has a consistent level of quality and/or quantity which might provide the basis for a universal disposal method

4. there is a universal economical method of debris removal and/or disposal that can be used at all or most impoundments.

Discussion of Current Disposal Methods

The five basic methods to dispose of cleaning debris removed from COE impoundments are:

1. placing the debris on the ground to decompose

2. burying the debris with or without processing to reduce its volume

3. selling the debris unprocessed

4. processing the debris for sale as mulch, firewood, etc.

5. burning the debris using confined or unconfined burning techniques.

Although Corps personnel have used all of these methods, responses to the questionnaire sent to the COE Divisions in 1974 indicate that most project managers practice unconfined burning. Of the 180 respondents to a question regarding the debris disposal method used, 125 (69 percent) use unconfined burning, 41 (23 percent) use burial, eight (5 percent) use pit incineration, and six (3 percent) use chipping.

Questionnaire responses indicated that chipping and burial in a sanitary landfill are the most expensive debris disposal methods.

Unconfined burning is the most restricted and regulated method of debris disposal practiced by project managers. Current environmental legislation and enforcement trends indicate that unconfined burning will soon be prohibited in some areas of the United States, particularly the Pacific Northwest and areas adjacent to large urban centers.

2 SITE VISITS

The results of the questionnaire indicated that 31 Corps impoundments have major debris disposal problems. Four of these locations in different physiographic regions of the United States were selected for detailed research and visits to obtain site-specific information regarding removal and disposal operations. These impoundments were created by the following locks and dams: Millers Ferry Lock and Dam located on the Alabama River near Camden, AL; Lock and Dam No. 25 located on the Mississippi River near Winfield, MO; John Day Lock and Dam located on the Columbia River near The Dalles, OR; and Franklin Falls Dam located on the Pemigewasset River near Franklin, NH.

Four other COE impoundments located in the general vicinity of the selected sites were also visited. These included Jones Bluff Lock and Dam, located on the Alabama River between Selma and Montgomery, AL; Foster Dam and Green Peter Dam, located in the headwaters of the South Santiam River near Sweet Home, OR; and The Dalles Lock and Dam, located on the Columbia River near The Dalles, OR (Figure 2).

Unconfined burning is used to dispose of cleaning debris at six of the impoundments visited. At two of the locations, the project managers dispose of floating debris by flushing it downstream.

This chapter provides a thorough discussion of the four sites selected for detailed research and a summary of the other four site visits. All prices listed for equipment and materials are prices quoted in May and June of 1975.

Millers Ferry Lock and Dam, AL

Description

Millers Ferry Lock and Dam, located across the Alabama River in Wilcox County near Camden, AL, was visited during the week of 9 March 1975. Figure 3 is an aerial photograph of the dam and powerhouse. From left to right (west to east), the structures in the figure are a long earth dike extending from the high ground to the river; a gated spillway across the original river channel; a lock at the east end of the spillway; an earth dike extending downstream at a right angle to the spillway axis; a powerhouse at the end of this dike; and a short dike extending east from the powerhouse to high ground.

The dam backs up the Alabama River to a minimum depth of 9 ft (2.7 m), creating a navigable channel 103 mi (165.8 km) long. The drainage area above the dam is 20,700 sq mi (53612.8 km^2), and the approximate length of the reservoir shoreline is 516 mi (830.4 km). At normal pool levels, the lock provides a 45-ft (13.7-m) lift. Pool fluctuations are very small near the dam (1 to 2 ft [0.3 to 0.6 m]). Normal conditions and flood levels may differ 10 to 15 ft (3.0 to 4.6 m) in upstream areas

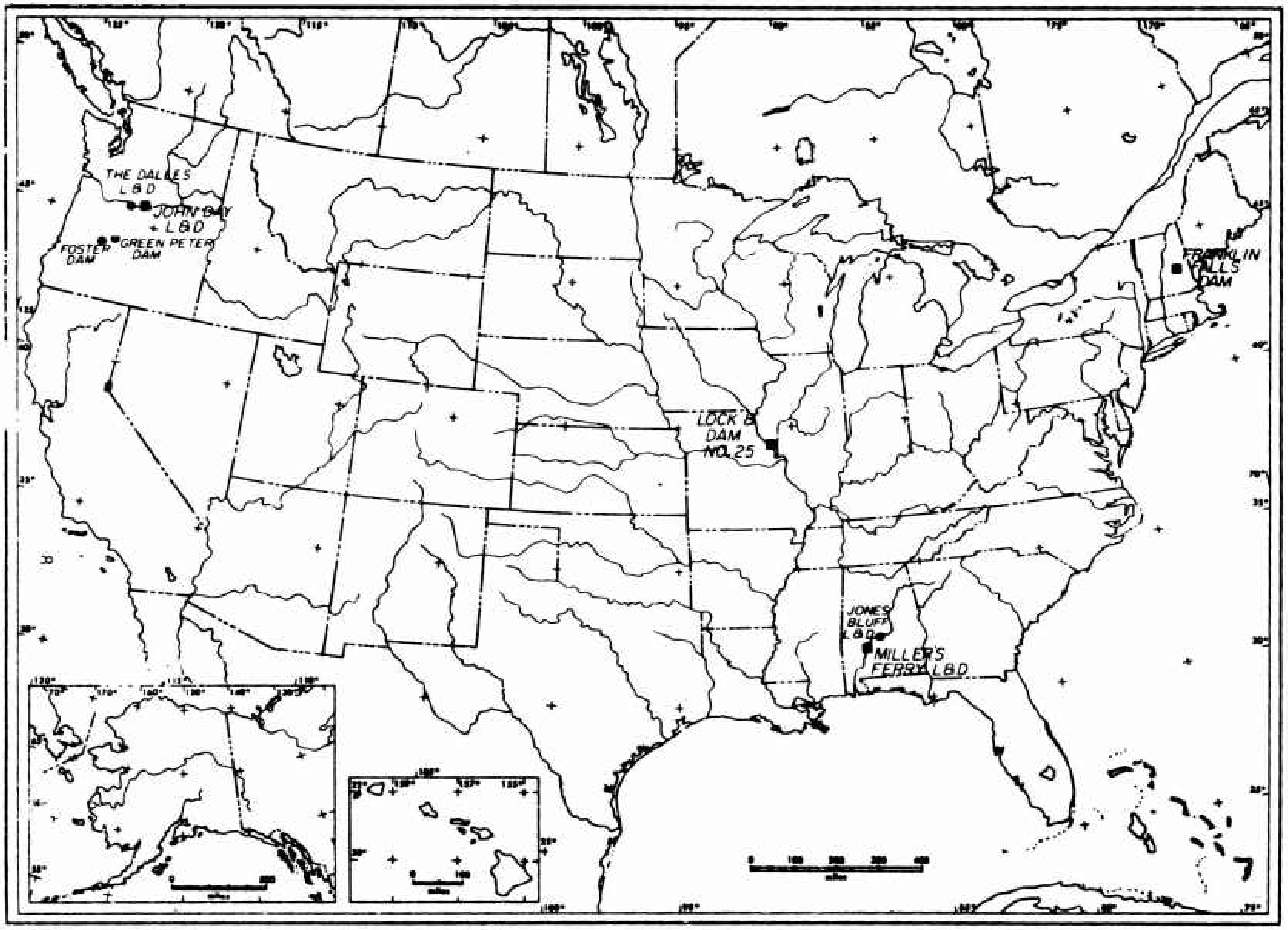

Figure 2. Location of visited sites.

where the floodplain narrows and in the tributaries. At the powerhouse intakes, water depth is between 65 and 67 ft (19.8 to 20.4 m).

The average river flow at the dam is 30,300 cu ft/sec (858.0 m^3/sec). The dam's primary function is navigation; its secondary functions are power generation and public recreation. Table 1 provides additional information regarding the lock, dam, and powerhouse at Millers Ferry.

Debris

There are two major sources of debris at Millers Ferry Lock and Dam. The first one is areas permanently inundated by shallow water that were not cleared of trees before the reservoir was filled. The trees in these low areas (which include portions of islands) have died and are falling into the reservoir. Several such areas are located approximately 2.5 mi (4.0 km) upstream from the dam. The second source of debris is the trees growing on the banks of tributaries and reservoir. As the banks erode, the trees fall into the water and eventually float down to the dam. A third, but insignificant source is debris that is pushed or thrown into the reservoir.

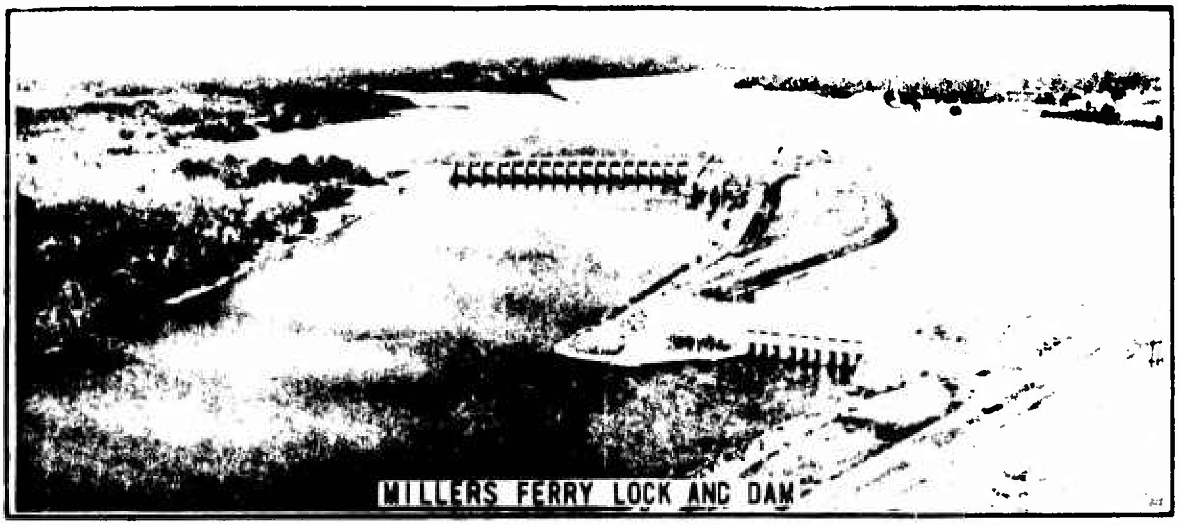

Figure 3. Millers Ferry Lock and Dam.

Table 1

Data - Millers Ferry Lock and Dam

LOCK, DAM, AND POWERHOUSE

Earth Overflow Dike on West Bank	
Length, ft (m)	3450 (1051.6)
Width at crest, ft (m)	25 (7.6)
Maximum height above natural ground, ft (m)	15 (4.6)
Spillway	
Length, ft (m)	940 (303.0)
Height of bridge above stream bed, ft (m)	90 (27.4)
Number of tainter gates	17
Size of gates, ft (m)	50x35 (15.2 x 10.7)
Lock	
Inside chamber dimensions, ft (m)	84x600 (25.6 x 182.9)
Minimum water depth over sills, ft (m)	13 (4.0)
Maximum lift, ft (m)	48 (14.6)
Height of upper gate, ft (m)	26 (7.9)
Height of lower gate, ft (m)	68 (20.7)
Earth Nonoverflow Dikes on East Bank	
Total length, including lock mound, ft (m)	5800 (1767.8)
Width at crest, ft (m)	32 (9.8)
Maximum height above natural ground, ft (m)	27 (8.2)
Powerhouse	
Length, ft (m)	320 (97.5)
Width, including substructure, ft (m)	168.5 (51.4)
Height of structure, ft (m)	165 (50.3)
Number of generating units	3
Capacity of each unit, kW	25,000
Average annual energy output, kW	408,000,000

A possible future debris source is a landing for shipping and receiving wood. Four local companies which specialize in timber products are currently planning to construct a landing for loading and unloading wood on the Alabama River upstream from the dam. Spills from barges or at the landing could produce more debris at the dam.

Most of the debris is wood in the form of logs, branches, and occasionally, entire trees. In addition, the debris contains some plastic bottles, balls, rubber items, and glass. The wood debris is in various stages of decomposition, due to the frequent wetting and drying that occurs as it moves downstream. It ranges in size from small twigs and pieces of bark to whole trees, roots, branches, and boles up to 3 ft (0.9 m) in diameter and ranging from 80 to 100 ft (24.4 to 30.5 m) long.

In 1972, approximately 500 tons (453.7 metric tons) of debris were removed from the water at the powerhouse, and approximately 870 tons (789.5 metric tons) were removed in 1973. No records were available for 1970 and 1971.

The debris does not create problems at the spillway or locks where it is flushed through, or at the recreational areas. Although some people have damaged their boat engines on submerged or partially submerged logs, they have not yet complained to the resource manager about their damaged property.

The major problem occurs at the powerhouse. When the gates are closed on the spillway and the powerhouse is operating, the water flows to the east side of the dike toward the powerhouse (Figure 3). The floating debris is carried into a trap created by the dike on the west, the east bank of the reservoir on the east, and the powerhouse on the south. Since there is no way to flush the debris through or around the powerhouse intakes, it must be removed from the water to prevent it from blocking the water flow into the powerhouse.

The quantity of debris during high water conditions necessitates removal of debris at least two or three times per week. These conditions occur throughout the spring and once or twice during the rest of the year when rainfall is heavy in the watershed.

Approximately 80 percent of the debris (697 tons [632.2 metric tons] in 1973) is removed by a modified front-end loader positioned on the bow of a boat (Figure 4). The boat moves into the debris floating against the powerhouse intakes and scoops it into the loader (Figure 5). It then dumps the debris on a barge anchored about 75 yd (68.6 m) upstream (Figure 6). The barge holds approximately 30 to 40 tons (27.2 to 36.3 metric tons) of debris, depending on how wet the debris is (Figure 7).

Approximately 20 percent of the debris (174 tons [157.8 metric tons] in 1973) is submerged near the powerhouse intakes and removed by a 20-ton truck-mounted crane with a clamshell. The crane is driven onto the roadway at the north side of the powerhouse where it lifts out the debris, placing it on the roadway or barge.

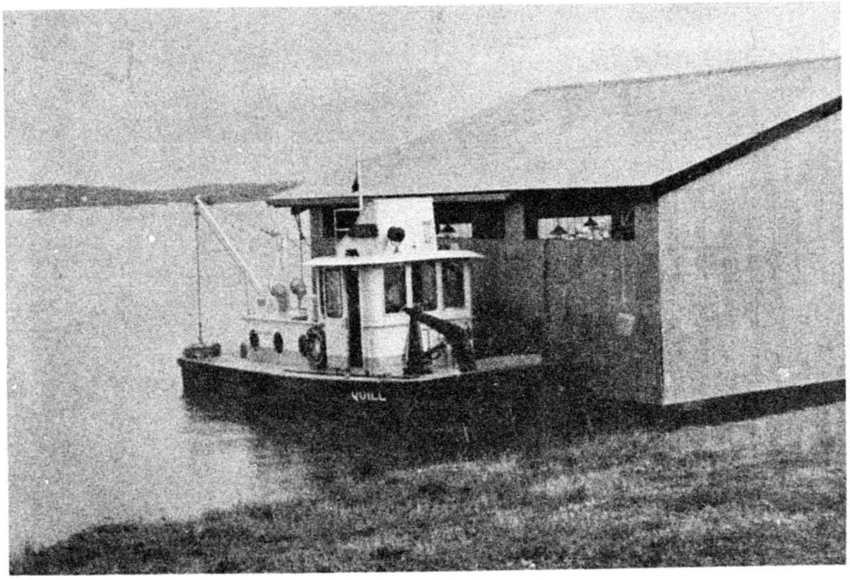

Figure 4. Debris boat at Millers Ferry Lock and Dam.

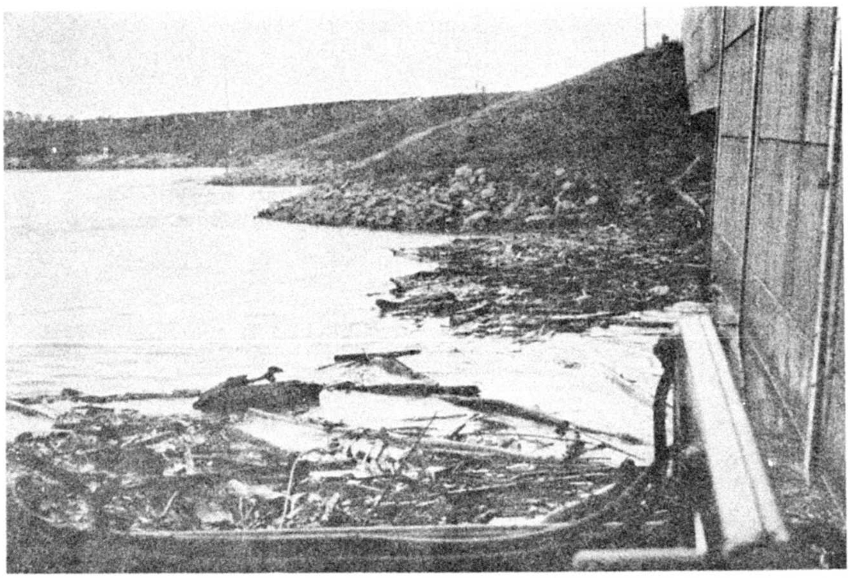

Figure 5. Debris at Millers Ferry powerhouse.

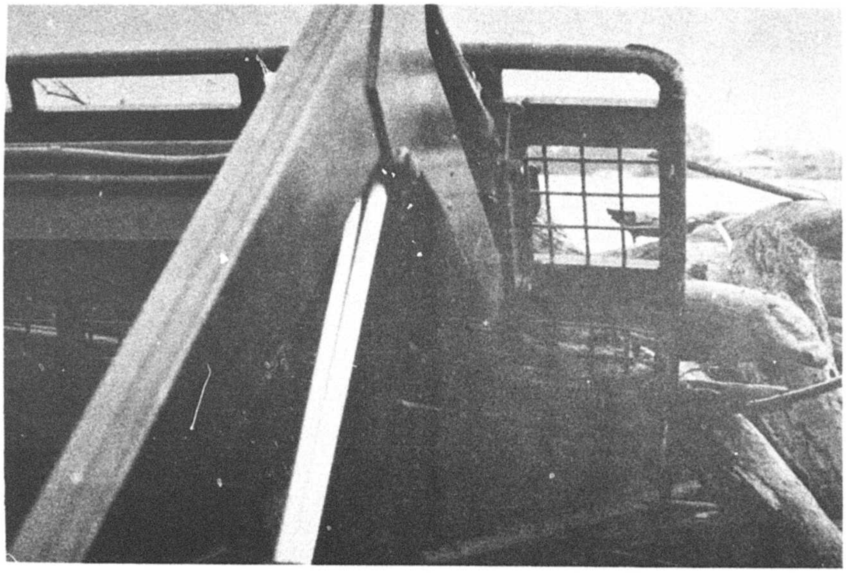

Figure 6. Loading of debris barge at Millers Ferry Lock and Dam.

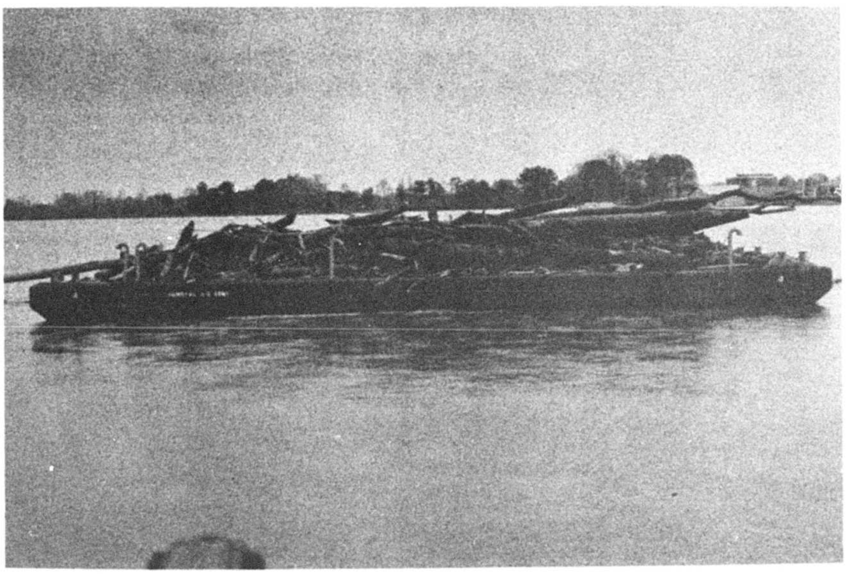

Figure 7. Debris barge.

The crane is not capable of removing larger pieces of debris which have sunk into the 65 ft (19.8 m) of water near the powerhouse intakes. When large trees are found in the trap, the debris boat pushes them aground where they are cabled to the shore to prevent them from floating near the powerhouse intakes. The crane, boat, and barge are kept permanently at the powerhouse.

To prevent floating debris from moving down to the powerhouse intakes, piling was driven north of the powerhouse, and a fence was constructed into the water from the dike and east bank of the reservoir (Figure 3). It is difficult to position the boat for removal of debris stopped by the fence, since the boat's front-end loader often gets caught in the wire. In addition, because the fence is positioned from the banks and does not extend into the center of the main water course, most of the floating debris still reaches the powerhouse.

Present Disposal Method

After the barge has been loaded with debris, the debris boat moves it to the burn area located at the north end of the dike connecting the spillway and the powerhouse (Figure 8). The crane is then used to unload the barge. Submerged debris placed on the roadway at the north side of the powerhouse is loaded onto trucks and moved to the burn area.

In the burn area, the debris is piled on the ground for drying. During favorable weather conditions, it is disposed by unconfined burning (Figure 9).

The dam and burn area are located in a remote area of Alabama. Camden, AL (population 2000), the largest community in the area, is located approximately 10 mi (16.1 km) from the lock and dam.

Water surrounds the burn site, which is approximately 1/2 mi (0.8 km) from both east and west banks of the reservoir. The burn area is approximately 1 mi (1.6 km) from the closest reservoir recreational area. The Lee Long Bridge on State Highway 28 is located approximately 1/2 mi (0.8 km) north of the burn area. Several homes are located on the dike approximately 1/4 to 1/2 mi (0.4 to 0.8 km) south of the burn area.

The main commercial activities of the area are silviculture and timber products. There is some grazing and row crop agriculture, but the amount is insignificant. There has been no adverse public response to the present disposal operation.

The Area Corps of Engineers Office at Tuscaloosa, AL controls Jones Bluff Lock and Dam, Millers Ferry Lock and Dam, and Claiborne Lock and Dam. One resource manager and two assistants manage all three projects. Millers Ferry has a powerhouse, and one is now under construction at Jones Bluff; one manager will manage both powerhouses.

Figure 8. North point of dike at Millers Ferry Lock and Dam.

Figure 9. Present burn site at Millers Ferry Lock and Dam.

At Millers Ferry Lock and Dam, the number of employees who can remove and dispose of the floating debris is limited. They must be diverted from their regular jobs and assigned to debris disposal when necessary.

The resource manager employs one laborer who can be used for the debris work. He is a licensed pilot and is assigned responsibility for operation and maintenance of the debris boat and barge, as well as other duties at the garage and headquarters building. The powerhouse manager employs two laborers and one janitor who are periodically assigned to debris disposal. Mowing and garbage pickup disposal at recreational areas are contracted out by the resource manager.

From 1972 to 1973, the amount of debris removed at the powerhouse increased by 372 tons (337.4 metric tons). If these conditions persist, more money and personnel will be required to handle the increasing volume of floating debris. If the debris is not removed, the powerhouse will not always be able to meet the demands of the Alabama Power Company.

Physical Environment

Millers Ferry Lock and Dam is located in the Gulf Atlantic Rolling Plain. The upland forest areas are characterized by Loblolly-shotleaf pine. The lowland forest areas are composed of oak, gum, and cypress. The north end of the reservoir is located in the Blackbelt Grasslands.

The mean average monthly temperatures for January and July are 50°F (10°C) and 90°F (32°C), respectively. The average annual precipitation for the area is 53 in. (134. 6 cm). Approximately 4 to 6 in. (10.2 to 15.2 cm) of precipitation occur every month except September, October, and November, when approximately 2 to 4 in. (5.1 to 10.2 cm) occur. The average annual surface runoff is 20 in. (50.8 cm). The lowest stream flow is in late summer and fall, while winter is the season of highest stream flow.

Wind direction varies throughout the year. The mean wind direction for January is westerly. During April, the mean wind direction is southwesterly. July is characterized by winds from the south, and October by winds from the northeast.

The floodplain is characterized by immature alluvial soils which vary in depth over the bedrock. Limestone outcrops are visible in the uplands adjacent to the dam. There are unconsolidated, loose sand and gravel, and semiconsolidated, partly cemented aquifers in the area. The depth of the water table varies seasonally; it is relatively close to the surface in the floodplain, except during low stream-flow periods.

The upland soils are clays and loams. Approximately 50 to 80 percent of the area is gently sloping; approximately 50 to 75 percent of this sloping land is in the lowlands. Local relief is from 100 to 300 ft (30.5 to 91.4 m).

Safety

Due to the mild winters, visitors use the recreational areas near the dam throughout the year. The present location of the burn area is visible from the headquarters building and has limited access. It is relatively easy to prevent visitors and workers from entering the dike area.

Environmental Considerations

The land in the immediate floodplain, uplands, and intervening slopes is used for silviculture or farming. Land use in the vicinity of the burn area is not adversely affected by the removal and disposal operations at the powerhouse and dike.

Groundwater is not affected by present removal and disposal operations. The reservoir periodically inundates the burn area, but the pool level usually remains constant at the dam, with normal variations being 1 to 2 ft (0.3 to 0.6 m). During periods of inundation, ash and partially burned debris are picked up by the water. No tests have been conducted to determine the impact on the water, but during flood conditions, the dilution factor would be high.

Air quality in the immediate vicinity of the burn area is affected by the burning operation. If the wind is from the south, smoke may obstruct vision on the Lee Long Bridge; this is highly unlikely under most operating conditions. If the wind is from the north, smoke and particulates may be blown toward the residences on the dike and the control house at the lock.

Burning of wood debris usually causes emission of four of the five combustion products associated with air pollution--particulates, carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NO_x). Sulfur oxides (SO_x) are rarely produced by unconfined burning. No tests have been conducted at the site to determine the specific effects of the burning operation on air quality or to determine the effects of noise, shock, or vibration on the environment.

Legal Considerations

Managerial personnel at Millers Ferry indicated that there may be future conflicts with state and local laws regarding unconfined burning on the dike. Presently, however, there are no known seasonal burning regulations or permit requirements relating to unconfined burning operations at the dam.

Burning has been an accepted silviculture practice used to clear forests, fields, and pastures of unwanted vegetation. If burning is prohibited, forest and field-clearing costs may increase substantially.

Firetowers have been constructed, and state forestry personnel maintain a fire watch on forests located in the dam vicinity. The resource manager notifies these personnel before burning operations begin so they will know the source of the smoke.

According to reservoir personnel, there is no state-approved landfill in Wilcox County although there are plans to construct one. Under current state laws, towns or counties must establish sanitary landfills. State residents are prohibited from burning trash, tree limbs, or other debris in their yards. It has not yet been determined how current proposed legislation will affect disposal operations at the dam.

Economic Considerations

The average annual cost for removing the debris at Millers Ferry Lock and Dam is $25,000. The average annual cost for disposing of the cleaning debris is $20,000. For the years 1972 and 1973, the approximate cost for removing the debris was $36/ton ($39/metric ton), while the approximate cost for disposal was $29/ton ($31.9/metric ton).

At Millers Ferry Lock and Dam, the debris is "trapped" at the powerhouse intakes. If it is not removed, it interferes with the generation of hydroelectric power, resulting in a revenue loss.

Since the wood is not processed before it is burned, there are no processing costs. When debris is removed from the water, the barge moves it to the disposal site. The boat used to remove the floating debris is also used to move the barge to the disposal site where the crane unloads it. This process minimizes handling and transportation costs.

The cheapest disposal method would involve no costs related to handling, transportation, and processing of the debris. Although flushing the debris downstream is relatively inexpensive, it often passes the problem to the next dam and/or interferes with navigation and hydroelectric power operations. Flushing causes losses to dams generating hydroelectric power, since water used to flush debris cannot be used to generate electricity.

Present and future market demands for the wood debris appear to be nonexistent.

Analysis (Millers Ferry Lock and Dam)

When the information required by the alternative evaluation outline was collected, researchers analyzed five alternative debris disposal methods.

1. Placement of the debris on the ground for decomposition. There is no place on Corps property where the debris could be spread or piled. The banks of the reservoir are steep and covered with rip-rap near the powerhouse. Although the Corps manages property adjacent to the reservoir,

such as recreational and boat access areas, seasonal floodwaters would carry debris spread in most of these areas back into the reservoir.

Open areas in the vicinity of the dam, suitable for spreading or piling the debris on the surface, are owned privately or by corporations. It is highly unlikely that any of these owners would want their cleared pasture or crop land to be covered by debris, due to the fire and insect hazards. In addition, placement of debris on the ground would make access into timberland near the dam difficult.

Considering the amount of debris (1370 tons [1242.4 metric tons] in 1972 and 1973, or approximately 39 bargeloads) and the rate of decomposition, a large area would be required to handle the amount of debris currently being disposed of. Additional transportation costs for hauling the debris to a distant disposal site would also have to be considered.

There are no known statutes prohibiting this method of disposal in Alabama.

2. Burial of the debris with or without processing to reduce its volume. Suitable land for such a disposal method is not available in the dam area. The land managed by the Corps is primarily in the floodplain. Since the water table is high in such areas, burial operations would present a problem.

Off-site disposal by decomposition and burial was considered; however, the closest landfill is 30 mi (48.3 km) from the dam site. It is highly unlikely that a landfill owner would accept the large volume of debris that has been removed from the powerhouse at Millers Ferry Lock and Dam for burial, since such large volumes would reduce the landfill's longevity. In addition, wood debris rotting and allowing the surface cover of a landfill to subside would create a problem. Burial of the wood debris might also provide an ideal habitat for termites or other insects.

The reservoir does not have the equipment necessary to haul large pieces or volumes of debris for long distances. Therefore, this equipment would have to be acquired, or the debris would have to be processed to reduce it in size for hauling by smaller equipment. Either alternative would require the purchase of more equipment, which would increase the capital investment and operating costs.

There are no known statutes prohibiting this disposal method in Alabama.

3. Selling the debris with no processing. There are four timber and pulp companies in the area surrounding the reservoir. The closest is at Pine Hill, AL, about 25 mi (40.2 km) from the dam. It uses oil and gas for fuel and burns the waste wood from its lumber processing; however, the company is not interested in using the wood debris,

because most of it is of poor quality. Since transporting the debris to the other companies would be economically unfeasible, they were not contacted. There are no known legal problems associated with this method of disposal.

4. Processing the debris for sale as mulch, firewood, etc. No local market for firewood or mulch exists due to the remoteness of the dam location and its sparse population. Several homes in the area use wood fuel or burn it in their fireplaces, but there is little demand for debris-derived fuel due to the abundance of quality wood in the area.

Although wood is burned at some of the recreational areas managed by the Corps, special saws and other equipment would have to be acquired to process the debris for use as firewood. Processing such large volumes and reducing most of the logs to a size convenient for firewood would require several man-months. The cost of handling and transporting the wood to the site would also have to be considered.

Wood debris removed from the reservoir is in various stages of decomposition and has mud and sand embedded in it. Processing most of this debris for paper pulp would be difficult since the wood would tear rather than be cut; therefore, the chips would not be of uniform length or properly sized for paper pulp. In addition, sorting the debris suitable for paper pulp from the unsuitable debris would be quite expensive; it is questionable whether the market price would justify the costs.

Most of the wood debris could be chipped for mulch, but the processing equipment required to chip large pieces is quite expensive. Transportation to distant market areas would also increase costs. Since there is no demand in the area for such large volumes of wood mulch, the costs would not be justified.

There are no known statutes prohibiting these disposal methods in Alabama.

5. Confined or unconfined burning of the debris. The unconfined burning operation presently in use appears to be the most available, efficient, and economical means of disposal. However, the effect of unconfined burning on air quality may lead to state legislative action to prohibit or restrict its use.

Establishment of a confined burning operation (pit incinerator) on the dike between the spillway and the powerhouse would require capital investments for additional equipment and/or materials. Components necessary for open-pit incineration are the pit, the loading or charging equipment, and the air source (blower).

Tests would have to be conducted to determine the type of soil used to build the dike and how high the water table fluctuates in the dike. If the water table height and soil type permit, pits can be periodically excavated by the 20-ton crane. The residue can be covered and a new pit excavated as needed; the crane can also be used to charge the pit with debris during the burning operation.

If the water table is low enough to excavate a pit, but the soil type is not conducive to excavation, the pit can be lined to prevent its walls from caving in. Burning residue must be periodically removed and disposed from such a permanent pit.

Railroad boxcars have been used to line pits (Figures 10, 11, and 12). The current price range for a boxcar 40-ft (12.2 m) long is $250 to $550, excluding delivery costs to locations remote from terminals. For example, the Santa Fe Railroad sold and delivered a 40-ft (12.2-m) railroad boxcar to a remote location in California for $750. The boxcar cost $400, and the delivery charge for 250 mi (402.3 km) was $350.

Gondola railroad cars have been used to line pits, but their burning capacity is relatively small; ash must therefore be cleaned out frequently for the blower to operate effectively. Prices of gondola cars were not available, but it is assumed that they would not exceed boxcar prices.

Special refractory concrete can be used to line incinerator pits, which often reach temperatures ranging from 2100° to 2400°F (1149° to 1316°C). Such high temperatures break down normal cement used to bind aggregate. Special calcium-aluminate cement, when used to bind suitable aggregate, can withstand these high temperatures. Suitable aggregate includes crushed fire clay brick, crushed pottery saggers, calcined clays, and crushed insulating fire clay brick. (Appendix A contains a list of crushed firebrick suppliers). The appropriate cement/aggregate mixing ratio is 1:5.

To construct 1-ft (0.3 m) thick walls for a pit 40 ft (12.2 m) long by 8 ft (2.4 m) wide by 15 ft (4.6 m) deep would require 250 cu ft (7.1 m^3) (bags) of cement and 1250 cu ft (35.4 m^3) of aggregate.

Universal Atlas Cement Company of Pittsburgh manufactures a calcium-aluminate cement, trade name LUMNITE, at Gary, IN, with a current price of $6 per cu ft (1 bag) at the plant. The cement would have to be purchased through a dealer, so the minimum cost of 250 bags of LUMNITE would be approximately $1500 plus dealer markup and shipping costs.

Approximately 20 companies, centered in the eastern part of the United States, sell suitable aggregate. The prices vary, depending on supply and demand; shipping costs would have to be included in the total price. Walsh Refractories Corporation of St. Louis, MO, sells crushed firebrick suitable for refractory concrete for approximately $5 per 100-lb (45.4 kg) bag at their St. Louis plant. The cost for this aggregate would be approximately $6250.

In addition, lumber would have to be purchased for the concrete forms, and personnel and equipment acquired for mixing and placing the

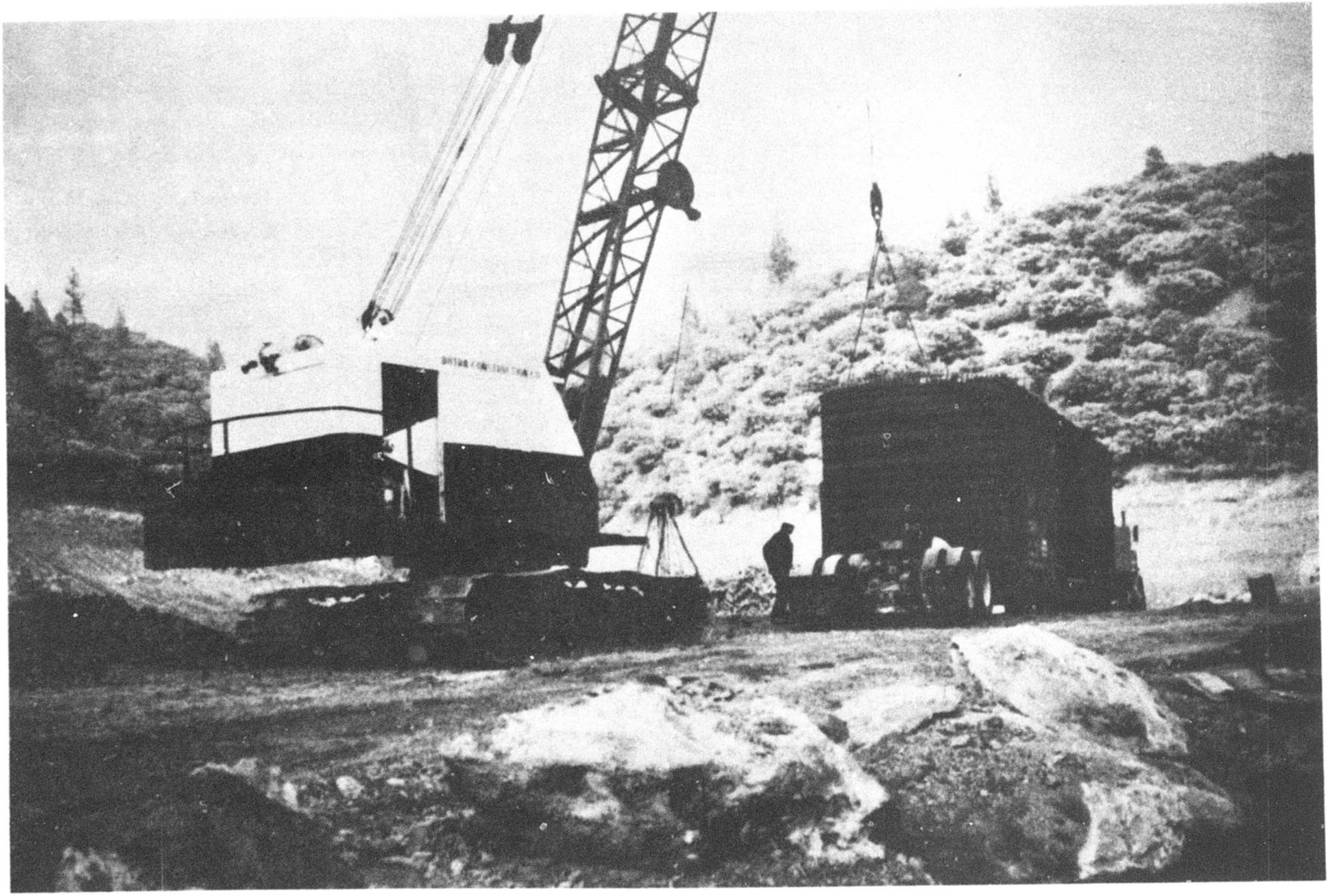

Figure 10. Unloading boxcar for incinerator pit.

Figure 11. Boxcar-lined pit in operation.

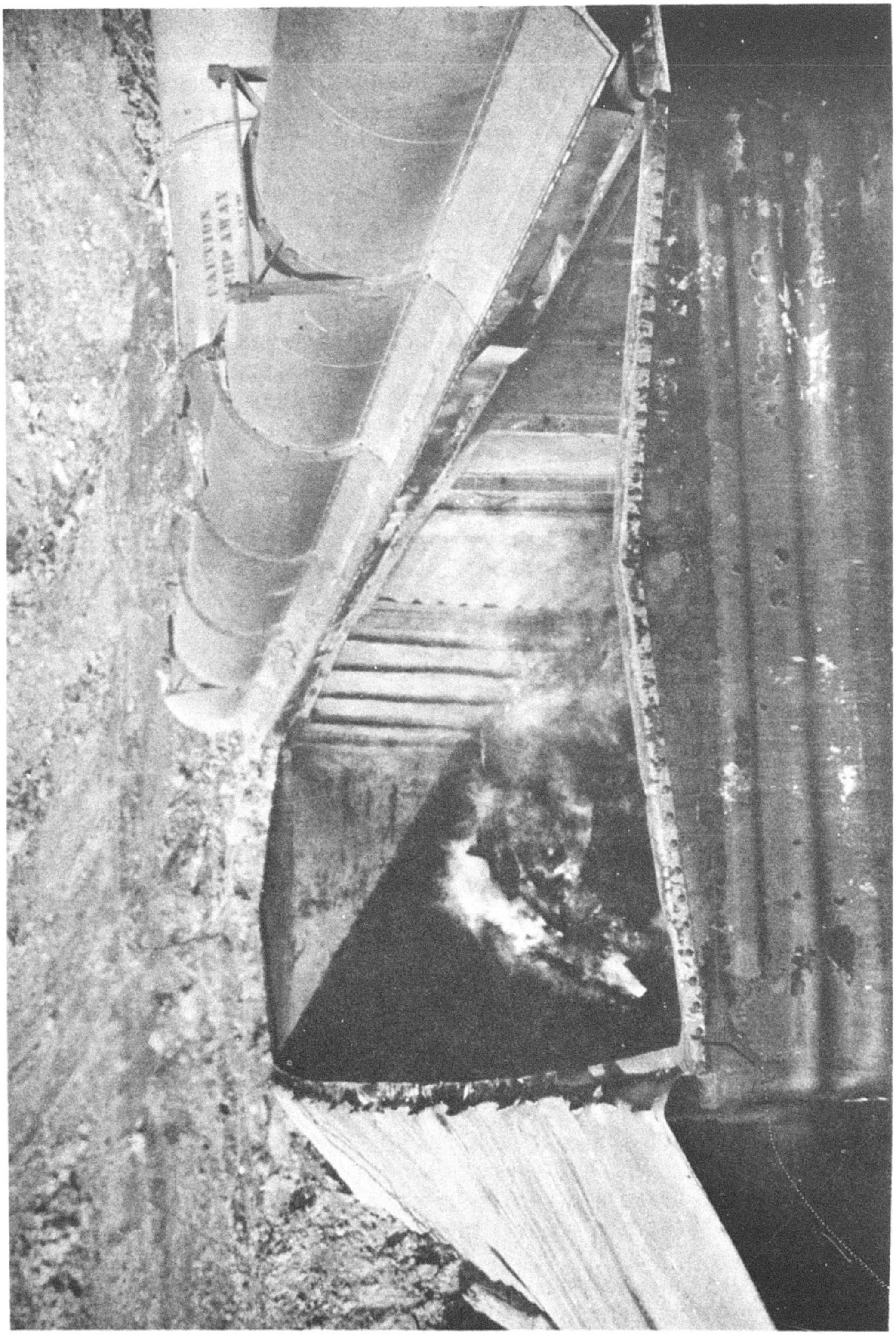

Figure 12. Debris burning in boxcar-lined pit.

concrete. It is evident that the purchase of railroad boxcars would be more economically advantageous on a first-cost basis; however, no information is available regarding the longevity of the two methods.

Most manufacturers recommend using a crane with a clamshell to charge pits during burning operations. It is safer than charging with a front-end loader, and it does not push dirt into the pit.

Several blowers are manufactured in the United States, and a few companies provide delivery, parts, and repair. For example, Driall Incorporated of Attica, IN, now manufactures five models of a blower under the trade name Air Curtain Destructor (ACD). The three stationary models, ACD-10, ACD-21, and ACD-42, have nozzle sections 10, 21, and 42 ft (3.0, 6.4, and 12.8 m) long, respectively. Their prices without a power source are $4693, $6872, and $10,620. The two portable models, ACD-21 and ACD-42, are mounted on their own rubber tire running gear; their prices without a power source are $7571 and $12,069, respectively.

The cost of a power source varies by option and model; an electric drive for an ACD-10 is $469, $787 for an ACD-21, and $1445 for an ACD-42. The cost for a diesel-engine drive for an ACD-10 is $3439, $4440 for an ACD-21, and $5446 for an ACD-42. The cost for a gasoline-engine drive for an ACD-21 is $2488, and $3627 for an ACD-42. The fuel tank with electric pump for all models and engines is $221.

Delivery rates vary with the model. One-way loaded rates for stationary models are: ACD-10 and ACD-21, $.68/mi ($.42/km); ACD-42, $.80/mi ($.62/km). The one-way rate for the portable ACD-21 is $.58/mi ($.36/km) and for the portable ACD-42, $.68/mi ($.42/km).

The portable models provide greater flexibility and can be moved to a number of sites. They could therefore also be used at Claiborne Lock and Dam and Jones Bluff Lock and Dam. Table 2 provides pertinent information on the two portable models of the Air Curtain Destructor.

The approximate burning capacities for the different ACD models are: ACD-10, 2 to 3.5 tons/hr (1.8 to 3.1 metric tons/hr); ACD-21, 4 to 7 tons/hr (3.6 to 6.2 metric tons/hr); and ACD-42, 8 to 14 tons/hr (7.2 to 12.6 metric tons/hr).

The capacity of the ACD-42 is twice that of the ACD-21, which would reduce disposal time by one-half. Since there is a shortage of personnel, it would be advantageous to minimize the number of people and the amount of time involved in the disposal operation.

Using the ACD-42, it would take approximately 80 hr to burn the 870 tons (789.5 metric tons) of debris removed in 1973 at 11 tons/hr (10.0 metric tons/hr). Since two people are required during most of the operation to safely handle the debris and operate the crane and ACD, approximately 160 man-hours would be required. Using the ACD-21 to

Table 2

Data on Air Curtain Destructor, Models 21 and 42

ACD-21	$7,571	ACD-42	$12,069
Gasoline Engine	2,488	Gasoline Engine	3,627
Fuel Tank	221	Fuel Tank	221
Delivery	406	Delivery	476
	$10,686		$16,393
Average Capacity - 5.5 tons/hr (5.0 metric tons/hr)		Average Capacity - 11 tons/hr (10.0 metric tons/hr)	
Estimated Life Span - 10 yr		Estimated Life Span - 10 yr	
Fuel Consumption - 2 gal/hr (7.6 liters/hr)		Fuel Consumption - 2 gal/hr (7.6 liters/hr)	

accomplish the same task would require approximately 320 man-hours. Thus, labor costs for disposing of a given amount of debris using the ACD-42 are approximately one-half the labor costs associated with the ACD-21.

The ACD-42 requires approximately the same amount of fuel to dispose of twice as much debris as the ACD-21; thus, the advantage of using the ACD-42 is obvious, since fuel costs are continually increasing.

Reducing long logs to fit the 42-ft (12.8-m) pit used by the ACD-42 requires less processing time than reducing them to fit the 21-ft (6.4-m) pit used by the ACD-21.

The air source (blower) equipment used for pit incineration is not guaranteed by manufacturers to comply with pollution codes for two reasons: first, it is not possible to specify or predict exactly what waste will be burned in the unit, and secondly, there is no reliable way to measure emissions from this type of unit. Future Alabama laws may prohibit or regulate the use of a pit incinerator to dispose of solid waste debris. Regulating agencies should be consulted before purchasing or using the equipment.

Conclusions for Millers Ferry Lock and Dam

At Millers Ferry Lock and Dam, unconfined burning has been used to dispose of cleaning debris because it is the most economical and convenient method. If legislation prohibits unconfined burning, however, there are five alternatives:

1. Placement of the debris on the ground for decomposition. This alternative is not presently available to the resource manager, due to limited land, equipment limitations, and transporting distances. Equipment and hauling costs make this alternative uneconomical at this time.

2. Burial of the debris with or without processing to reduce its volume. This alternative is not open to the resource manager, due to the limited land, equipment limitations, and distances involved. Equipment and hauling costs make this alternative uneconomical at this time.

3. Selling the debris with no processing. No market was found for the debris under present economic conditions. Potential local markets would not accept it, even at no charge, because they did not want to remove it from the site.

4. Processing the debris for sale as mulch, firewood, etc. No market is available to support the necessary processing costs.

5. Burning the debris by confined burning techniques. Confined burning by pit incineration is an available, moderately priced technique.

Although burning is not the most desirable disposal method, because it totally eliminates a resource without benefit to man or the environment, it may now be the only alternative, if unconfined burning is prohibited.

Legislation to eliminate present unconfined burning operations will necessitate increased expenditures by the Corps at the site.

The amount of clearing debris removed at the powerhouse increased by 370 tons (335.6 metric tons) between 1972 and 1973. It is hoped that an annual increase of this magnitude will not continue, but the amount of cleaning debris can be expected to increase for several more years.

Recommendations for Millers Ferry Lock and Dam

The site investigation indicates that there is a lack of land near the reservoir suitable for spreading, piling, or burying the debris. The cost of equipment for processing and transporting the debris to distant disposal sites is prohibitive. Transportation costs have increased substantially during the last 2 years, and they are expected to increase next year. If a suitable disposal site becomes available near the dam, these alternatives should be reevaluated.

At this time, no market will accept or purchase the debris; however, in the future, as the demand for wood products increases and wood processing technology advances, debris from reservoir cleaning operations may find a market. Market alternatives should be reevaluated periodically to investigate the possibility of using wood debris beneficially.

The investigation indicates that if legislation to prohibit unconfined burning is enacted, the Corps should establish a pit incinerator near the present burn site, provided such an operation is not also prohibited by law or the physical limitations of the site. The procedure for removing floating debris at the powerhouse should be retained for the present.

During low flow periods (late summer and fall) a large crane should be moved to the reservoir to assist with removal of submerged debris that the 20-ton crane is incapable of lifting. This could be scheduled for the down period at the powerhouse which occurs at this time.

Using the present procedure, the debris should be moved, piled, and allowed to dry near the present burn site. When the debris has dried sufficiently and weather conditions are favorable, it should be burned in a pit incinerator.

A blower must be acquired to modify the operation, provided the soil and level of water table are conducive to pit excavation on the dike. The ACD-42 or a comparable model would be the most advantageous model to use at Millers Ferry Lock and Dam in terms of capacity and operating costs. If prices and operating specifications of blowers manufactured locally are found to be more advantageous, they should be acquired instead of the ACD.

Pits can be excavated periodically to dispose of debris, but for long-term disposal activities, as anticipated at Millers Ferry Lock and Dam, a permanent pit should be constructed.

It is recommended that the Corps purchase a standard-length, steel railroad boxcar to line the pit. The length of the ACD-42 has been found to be compatible with the 40-ft (12.2-m) boxcar.

Lock and Dam No. 25, MO

Description

Lock and Dam No. 25 (Figure 13) located across the Mississippi River near Winfield, MO, was visited during the week of 24 March 1975. The only access road to the dam is across the Mississippi floodplain in Lincoln County, MO. The road crosses Sandy Slough to Bradley Island at the west end of the dam. The project buildings are located on 5 acres (2.0 hectares) at the south end of Bradley Island. The north side of the island is a 10-acre (4.0-hectare) recreational area having a shelter house, restrooms, picnic tables, and fireplaces. This area (Figure 14) has a levee parallel to the Mississippi River on the east side.

The dam (Figure 15) is adjacent to Bradley Island. Beyond the lock is a gated spillway across the original river channel. East of the spillway is an earth dike extending to the east bluffs of the Mississippi River in Calhoun County, IL. The federal government maintains 5 mi (8.0 km) of levee in the dam area.

The primary function of the dam is to maintain a 9-ft (2.7-m) navigation channel. Pool No. 25 extends for 30 mi (48.3 km) upstream to Lock and Dam No. 24 located at Clarksville, MO. The pool shoreline is approximately 60 mi (96.6 km) long, and there are many islands in the pool. Many creeks and streams drain into the pool from the adjacent uplands in Illinois and Missouri.

A secondary function of the dam is to provide recreational facilities. Visitors use the recreational area for picnicking and fishing from April to October.

Debris

Tributaries which drain into the pool are the primary sources of debris. During periods of heavy runoff, debris (Figure 16) is flushed from the uplands and floodplain into the main course of the river. The islands and lowlands adjacent to the Mississippi River are other sources of debris. Trees are killed by high water or disease and

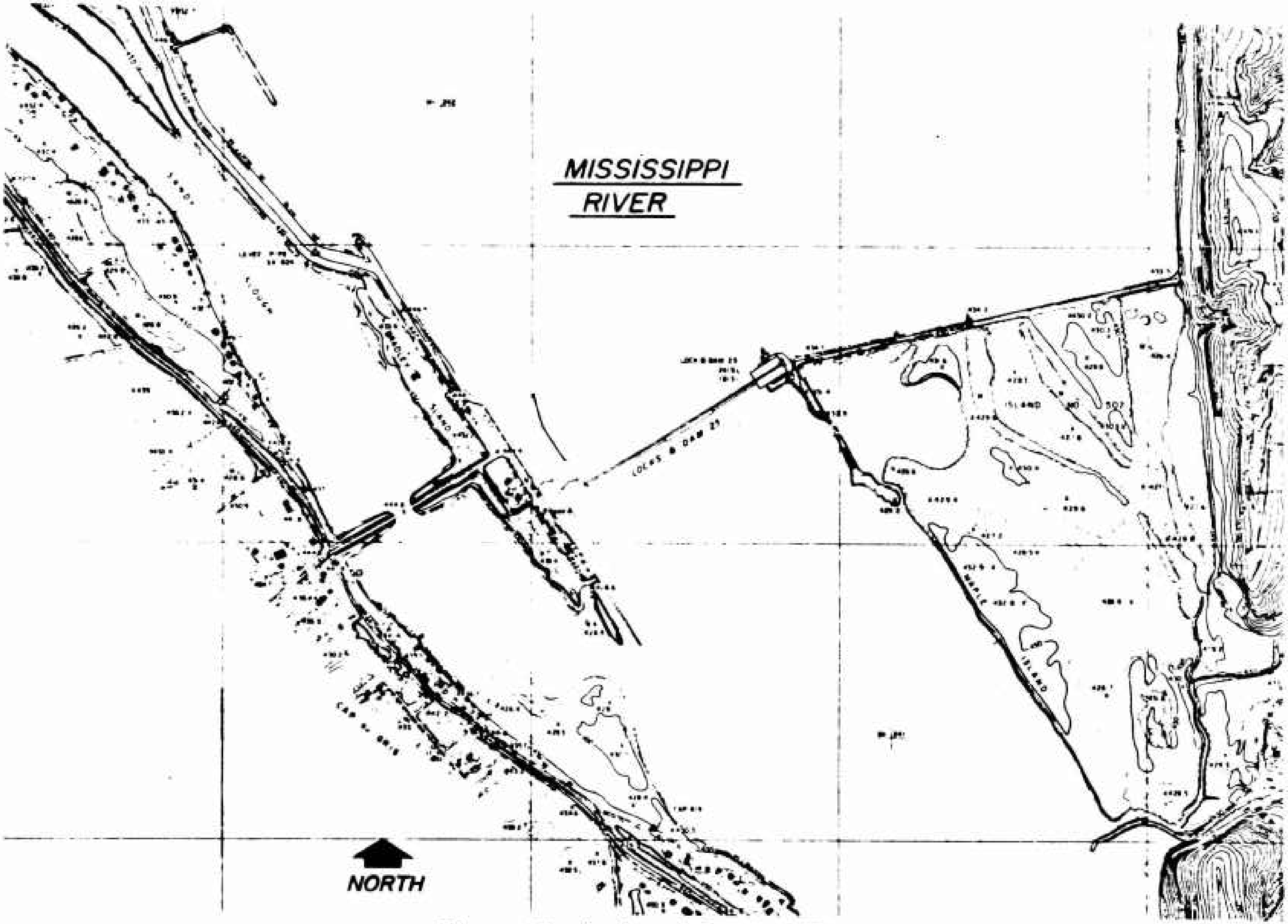

Figure 13. Lock and Dam No. 25.

Figure 14. Recreation area at Lock and Dam No. 25.

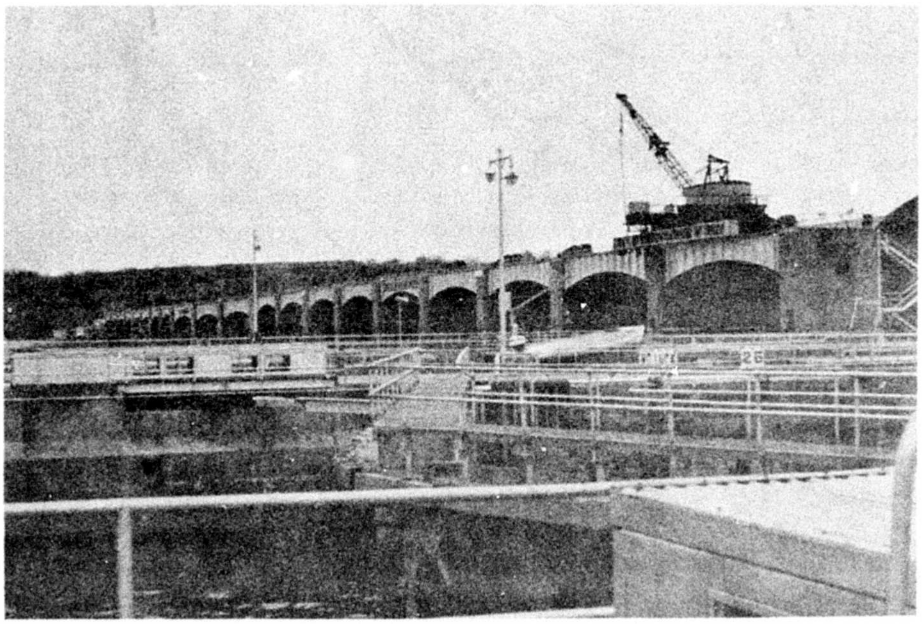

Figure 15. Gated spillway at Lock and Dam No. 25.

Figure 16. Typical debris at Lock and Dam No. 25.

eventually rot and fall to the ground. When the main river floods and inundates such areas, these trees are floated into the main channel.

Some natural debris is deposited in the river by erosion of the river bank. When the river undercuts the bank and erodes the soil, the upper portion, which contains vegetation falls into the river.

Plastic bottles and various other discarded objects periodically float into the dam and recreational area with the wood debris.

During land-clearing operations, people occasionally push debris into the river, or the river may inundate the area later and float the debris out. Figure 17 shows a land-clearing operation in the lowland just west of the dam. Almost all the clearing debris is wood, logs, branches, and occasionally whole trees 2 1/2 to 3 ft (0.8 to 0.9 m) in diameter and 60 to 80 ft (18.3 to 24.4 m) long.

In 1972, approximately 5000 acre-feet (500 acres, 10 ft deep [202.4 hectares, 3,0 m deep]) of debris were flushed through and burned at the dam. In 1973, the amount increased to approximately 6000 acre-feet (600 acres, 10 ft deep [242.8 hectares, 3.0 m deep]).

Debris seldom creates a problem at the spillway or locks; it is usually flushed through the gates, lock, or trash rack. Sometimes large trees or logs must be pushed or winched through the locks. Occasionally, the large crane positioned on top of the spillway is needed to lift

Figure 17. Clearing operation at Lock and Dam No. 25.

large logs out of the gates. These operations occur throughout the year.

The major debris problems occur in the recreational area. During periods of high water, debris floats into the area and is deposited as the water recedes. Although this may happen throughout the year, it generally occurs during the spring.

Access to the debris is limited. The low ground in the recreational area is wet and soft, which restricts vehicle movement. The levee, which is steep and often wet and soft, provides the only land access.

Equipment at the dam for removal and disposal operations is limited, consisting of one small tractor with a push blade, a 1-ton trailer, and a 1/2-ton pickup truck. A tractor with a front-end loader has been requested.

Present Disposal Operation

Fifteen people are permanently employed at the dam; during the summer, four additional aides are hired. There is a spring cleanup at the dam each year following the high water.

It takes approximately 4 man-months per year to dispose of all the debris in the recreational area. Most of the debris is piled, allowed to dry, and burned in the recreational area. Debris that is suitable for firewood is cut into smaller pieces and picked up by local residents. Most of this work is done by hand, since very little equipment is available.

Several summer cottages and some permanent residences are across Sandy Slough from the recreational area. The nearest communities are approximately 2 to 3 mi (3.2 to 4.8 km) from the reservoir. No complaints or objections have been filed by these residents regarding unconfined burning at the recreational area.

Periodic high water during the summer often deposits more debris in the recreational area. This debris must be cleared away so visitors can use the area.

Physical Environment

Lock and Dam No. 25 is located in the Middle Western Upland Plain, characterized by irregular plains; 50 to 80 percent of the area is gently sloping; 50 to 75 percent of the sloping area is upland. The local relief in this area is 100 to 300 ft (30.5 to 91.4 m).

Most precipitation occurs during the spring and early summer. Average annual precipitation is approximately 38 in. (96.5 cm). The average July precipitation is 3 in. (7.6 cm), and the average January precipitation is 2 in. (5.1 cm). Average annual runoff is 10 in. (25.4 cm). High stream flow usually occurs in March, and low stream flow occurs in late summer and fall. The average July temperature is 80°F (27°C) and the average January temperature is 40°F (4°C).

The wind generally blows from the south or west, with prevailing winds from the SSW in July, SW in October, W in January, and SW in April.

Limestone bedrock, which is found throughout the dam vicinity, occurs on the bluffs of the Mississippi River. Many caves are located throughout the area. The limestone is a consolidated aquifer.

The upland forested areas are oak-hickory, while the floodplains and lowlands are dominated by elm, ash, and cottonwood.

Upland soils are predominantly clay, except on the eastern bluff of the Mississippi River, where a layer of loess covers the limestone bedrock. The immature alluvial soils in the floodplain vary in depth over the bedrock. Often lenses of sand and gravel are found in the soil.

The water table is very shallow in the floodplain. Figure 18 is a typical view of the Mississippi River floodplain near Belleview, IL.

Much fill material has been placed on Bradley Island to construct the levee and high ground for the government buildings. The recreational area has not been disturbed and is characterized by immature, alluvial soils that are rich in organic material. The water table in the recreational area is just below the ground surface.

The floodplain is approximately 4 mi (6.4 km) wide in the vicinity of the dam. The Mississippi River is located in the eastern part of the floodplain at the base of the bluff.

Safety

Visitors primarily use the recreational area between 1 April and 31 October. Following normal flood conditions, debris is cleaned up and burned before the heavy visitor usage season.

The recreational area is visible from the government buildings, and the bridge over Sandy Slough provides limited access to Bradley Island. Consequently, it is relatively easy for dam employees to restrict visitor access to the recreational area during cleaning and disposal operations.

Environmental Considerations

The dam is located in a remote area approximately 35 mi (56.3 km) north of St. Louis, MO. Winfield, MO (population 500) is located 3 mi (4.8 km) west of the dam, and Batchtown, IL (population 200) is 2 mi (3.2 km) northeast of the dam.

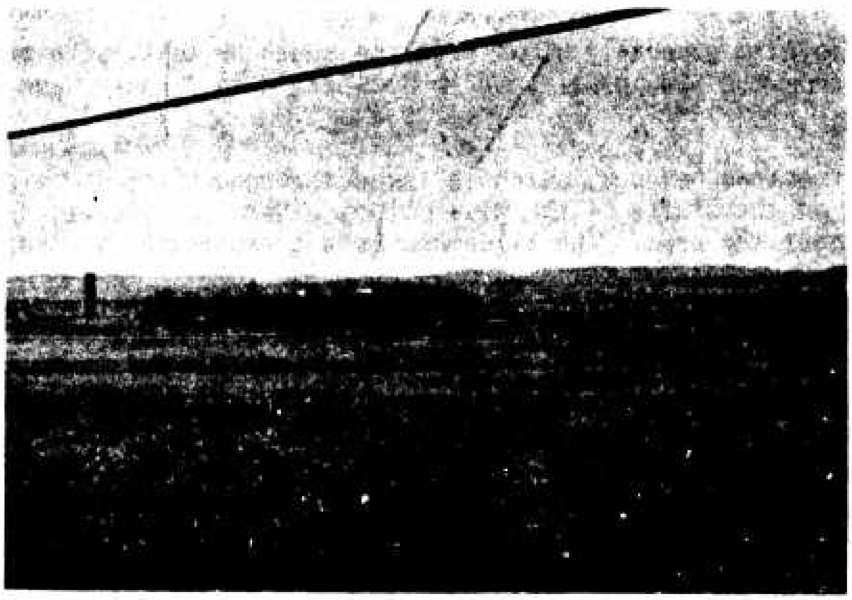

Figure 18. Mississippi River floodplain near Belleview, IL.

There are no highways near the dam. The floodplain west of the dam in Lincoln County, MO is dotted with dwellings; fields, pastures, and small timber stands dominate the landscape. Near the dam in Calhoun County, IL the population is sparse. Pastures, fields, groves of trees, and orchards dominate the landscape.

Summer cottages and permanent residences are located on the west bank of the Mississippi River adjacent to the dam. Present land uses do not appear to be affected by cleaning and disposal operations. Visitors are restricted from the recreational area during removal and disposal of debris.

Groundwater and surface waters are probably not affected by the present cleaning and disposal operations. When the recreational area is periodically inundated by the river, the floodwaters remove the burn residues. This residue probably does not affect the water quality, since the dilution ratio is quite large; however, no tests have been conducted to determine the degree of pollution.

Adverse noise, shock, and vibrations associated with cleaning and disposal operations occur during normal working hours at the dam. They probably do not affect area residents any more than normal activities associated with water transportation; no complaints have been made to government personnel. No tests have been conducted to determine the noise level of the cleaning and disposal activities.

Air quality is adversely affected by unconfined burning of debris. Burning during optimum weather conditions (prevailing winds) causes the smoke and gases to be blown away from the government buildings and adjacent dwellings. No tests have been conducted to determine the concentration level of the combustion products associated with air pollution.

Legal Considerations

There are no known regulations or permit requirements in Missouri restricting unconfined burning operations; however, personnel think that future state laws will affect the present method of disposal, although the degree of possible restriction is unknown. There was no information at local government offices which would indicate the current status of pertinent legislation in Missouri. Physical conditions are unfavorable for disposal of cleaning debris on the Illinois side of the Mississippi River. Because the physical conditions preventing access to the dam are expected to remain adverse indefinitely, moving the burn site to Illinois is not feasible if burning is prohibited in Missouri.

Economic Considerations

The average annual expenditure for removal and disposal operations at Lock and Dam No. 25 is estimated to be $30,000: $15,000 for collection, removal, and flushing and $15,000 for disposal. During 1972 and 1973, the total expenditures were approximately $5/acre-foot ($4000/cubic hectometer [Hm^3]) of debris.

Much of the debris is flushed downstream through the lock, spillway gates, or trash rack at Lock and Dam No. 25. Flushing is economically ideal because it is less expensive than a landfill, confined burning, or chipping; however, flushing the debris downstream increases the accumulation at the next dam, and thus passes on the removal and disposal expenses. The majority of the expense could subsequently be placed on one COE District responsible for the dams downstream. Also, debris released from the upstream dam may hinder and eventually stop navigation, hydroelectric operations, and/or recreational activities. Detailed studies of individual waterways are necessary to ascertain the total effectiveness and costs of flushing operations.

Present disposal operations in the recreational area at Lock and Dam No. 25 consist of piling and burning the debris. Most of the debris is moved by tractor and trailer. Although the wet conditions and large amounts of vegetation restrict vehicle movement, this method is most economically advantageous, since processing and transportation costs are minimized.

There are no markets for the debris in the immediate vicinity of the dam. Since the debris is in various stages of decomposition, sorting would be necessary to obtain wood suitable for processing. The small amount of wood suitable for firewood is cut up and hauled away by local residents. Due to the abundance of wood in the area, there is no great market demand for firewood or mulch, and therefore no need for debris-processing expenditures.

No area was located in the vicinity of the dam where the debris could be buried or spread out to decompose. The property managed by the Corps adjacent to the dam is not large enough to accommodate the large volume of debris which would accumulate after several years. The high water table in the lowland area restricts excavation for burial. If the debris were piled or spread in the area, periodic flooding would return it to the river, and hauling it long distances for disposal is not economically feasible.

Analysis (Lock and Dam No. 25)

Five alternative debris disposal methods were analyzed.

1. Placement of the debris on the ground for decomposition. The Corps of Engineers does not have enough suitable land adjacent to the dam for this disposal method. The floodplain west of the dam is used for mixed-grain farming and pasture. Low, wet areas have not been cleared of timber. Approximately 3 mi (4.8 km) west, the uplands and intervening slopes rising from the floodplain are used for farming and pasture. Steep slopes have been left in forest. It is highly unlikely that farmers or other rural residents would want rotting debris to be piled on their land.

The necessary large hauling equipment would be quite expensive. Operating expenses for hauling the debris would be high and expected to increase. Several firms in the St. Louis area have equipment to move the debris; however, use of contractor services was not deemed economically feasible, due to the long transporting distances.

2. Burial of the debris with or without processing to reduce its volume. No area in the dam's vicinity is suitable for a landfill because the water table in the floodplain is too high for excavations. The operating cost of equipment to transport the debris to a suitable location would be high and expected to increase.

3. Selling the debris with no processing. There is presently no local market for the debris.

4. Processing the debris for sale as mulch, firewood, etc. There is currently no market for firewood or mulch in the dam's vicinity; however, as the St, Louis suburbs expand, the demand for mulch and firewood may increase enough to justify processing and transportation costs. If this situation occurs, private companies may want to process the debris, thus greatly reducing disposal costs to the government; one problem, however, would be the inconsistency of debris quantity and quality.

5. Confined and unconfined burning of the debris. Unconfined burning is now used to dispose of debris in the recreational area. However, legislation prohibiting its use may be enacted.

A confined burning operation could be established at the dam. Since the water table on Bradley Island is too high to permit excavation for a subsurface pit, the pit would have to be constructed on the surface, with fill placed near the pit to support the blower. Fill would also have to be placed near the pit to provide access for charging it and insure personnel safety.

A standard, 40-ft (12.2-m) railroad boxcar could be used as a pit, but there would be a problem in placing the dirt around it. There should be approximately 1 to 2 ft (0.3 to 0.6 m) between the sides of the railroad car and the earth to allow for heat dissipation and prevent the sides of the car from buckling. This space would provide an area for floodwater to erode the soil. Consequently, the dirt would probably have to be replaced after each flood period. If dirt could be compacted around the sides of the pit and vegetation (grass) established, the possibility of erosion would be reduced.

A gondola car, although requiring more frequent cleaning, would also provide the necessary requirements. However, the lower walls do not allow much debris to be placed inside the car at one time.

A 40-ft (12.2-m) blower nozzle section would have to be used with the boxcar or gondola or they would have to be partitioned to provide the proper pit length for a shorter nozzle section. Partitions could be constructed using dirt or a refractory concrete wall. Cables placed across the car would support the walls where the partition is placed.

A concrete pit would probably be more durable than a railroad car, due to the adverse conditions created by periodic inundation.

A concrete pit equal in length to the blower nozzle could be constructed. Dirt could be placed against its sides to provide access for charging the pit and support for the blower. Table 3 provides pertinent information regarding construction of concrete pits for wood incineration. Two pit lengths--20 and 40 feet (6.1 and 12.2 m)--are considered. The wall thickness of each pit is 1 ft (0.3 m), although under certain conditions, 6 in. (15.2 cm) is acceptable.

Pit depth can be reduced from 15 ft (4.6 m). Tests have been conducted on pits 12 ft (3.7 m) deep with acceptable results. The reduced area in a shallower pit would require more frequent cleaning. No floor is necessary for a pit. Additional costs include materials for the forms, personnel, and equipment for mixing and placing the concrete.

Soil tests would have to be conducted to determine whether a raft foundation would be necessary to support a railroad car or concrete pit on the island's soft, wet soil.

There is no equipment available at the dam to charge a pit incinerator; acquiring it would be expensive. A tractor with a front-end loader has been requested, but it cannot lift large pieces of debris. Equipment is available at the dam for reducing large pieces of debris to more manageable sizes.

Use of confined burning will increase disposal time.

The blower size must be large enough to accommodate the quantity of debris but small enough to operate economically under other constraints, such as equipment available to reduce debris size; equipment available to move the debris; lifting capacity of the charging equipment; number of personnel; amount of suitable weather; and the frequency and seasonal variability of conflicting site uses by visitors.

Blower mobility is also an important consideration. The blower should be easily moved from the area during periods of high water or for use at other area dam sites.

The lockmaster should consult regulating agencies before purchasing disposal equipment. Future Missouri laws may contain special provisions concerning pit incinerator operations.

Conclusions for Lock and Dam No. 25

The unconfined burning operation at Lock and Dam No. 25 does not

Table 3

Data on Concrete Pits for Pit Incinerators

Pit size	40 ft long x 8 ft wide x 15 ft deep (12.2 m x 2.4 m x 4.6 m)	20 ft long x 8 ft wide x 15 ft deep (6.1 m x 2.4 m x 4.6 m)
Cement	250 cu ft (7.1 m^3)	150 cu ft (4.2 m^3)
Aggregate	1250 cu ft (35.4 m^3)	750 cu ft (21.2 m^3)
Cost of cement*	$1500 @ $6 per 94-lb bag (42.6 kg)	$900 @ $6 per 94-lb bag (42.6 kg)
Cost of aggregate+	$6250 @ $5 per 100-lb bag (45.4 kg)	$3750 @ $5 per 100-lb bag (45.4 kg)
Total cost of material at manufacturing plant	$7750	$4650
Max. temperature	2500°F (1371°C)	2500°F (1371°C)

* Price quoted by Universal Atlas Cement at their Gary, IN plant for LUMNITE cement, a refractory calcium-aluminate cement.

+ Price quoted by Walsh Refractories Corporation at their St. Louis, MO plant for crushed firebrick.

violate any known state laws. If future state or federal laws prohibit unconfined burning, the following alternatives must be considered:

1. Placement of the debris on the ground for decomposition. This alternative is not open at this time, since no suitable area is available near the dam.

2. Burial of the debris with or without processing to reduce its volume. There is no suitable land for burial in the dam's vicinity.

3. Selling the debris with no processing. There is no market in the area at this time.

4. Processing the debris for sale as mulch, firewood, etc. At this time, there is no market for firewood or mulch in the dam area.

5. Confined burning of the debris. Although confined burning will increase disposal costs, it is the only feasible alternative if unconfined burning is prohibited.

Recommendations for Lock and Dam No. 25

Land for piling or burying the debris is currently insufficient, and there are no markets for raw or processed debris. The lockmaster should periodically review these alternatives; if either land or markets become available, he should then determine the legal and economic feasibility of the methods.

A pit incinerator should be established at the dam if unconfined burning is prohibited (provided its use is not also prohibited).

The present method for cleaning the recreational area should be continued. Large pieces of debris should be reduced in size to enable them to be moved with available equipment. The debris should then be stacked, allowed to dry, and burned in a pit incinerator (provided its use is not prohibited also). The tractor having a front-end loader which has been requested will be adequate for charging the pit incinerator.

Determining the type of pit needed for disposal operations at Bradley Island was difficult. The quantity of debris accumulating in the recreational area during flood periods has not been determined, but is known to have increased during recent years. The water table is high and prohibits construction of a subsurface pit; periodic inundation will fill the pit with water and mud.

Research indicates that a modified railroad gondola car would be suitable for disposal operations. It is suggested that the pit be located near the north end of the recreational area. Soil tests should be conducted to determine whether a raft foundation is necessary to support the gondola car on the island soils.

An earth ramp must be constructed on one side of the pit to support the blower's nozzle section on the edge of the pit and provide access to the pit for the charging equipment. The tractor with the front-end loader should charge the pit from behind the nozzle section of the blower. This will prevent the driver from driving into the pit or from dumping debris on the nozzle section.

The blower should be placed on the upwind side of the pit to prevent the heat plume from overheating the blower engine. Charging from the upwind side of the pit will prevent the driver and tractor from being affected by the heat plume.

The depth of the gondola car will not accommodate a great deal of debris at one time, but lack of equipment would prevent the crew from moving and charging large amounts. If the amount of debris increases in the future, using a boxcar may be more economical. This would require different charging equipment, preferably a truck-mounted crane.

The portable blower ACD-21 with gasoline engine, or a comparable model, is recommended (see Table 2). The delivery cost to Lock and Dam No. 25 would be about $135. The ACD-21 burning capacity ranges from 4 to 7 tons/hr (3.6 to 6.2 metric tons). When used with the shallow gondola car, the ACD-21's burning capacity would be closer to 4 tons (3.6 metric tons). This burning capacity would be adequate for present quantities of debris and for any small increase that might occur.

When the blower is not being used at Lock and Dam No. 25, it could be moved to another Corps dam site. The present crew and equipment (including the requested tractor) are adequate for operating the pit incinerator at maximum efficiency.

John Day Dam, OR

Description

John Day Dam (Figure 19) is located across the Columbia River 29 mi (46.7 km) east of The Dalles, OR. The site was visited during the week of 7 April 1975. From north to south (left to right), the main parts of the John Day Dam include an earth dike, the navigation lock, a fish ladder, the gated spillway, the powerhouse, and a fish ladder.

The total length of the John Day Dam complex is 5900 ft (1798.3 m). The powerhouse's 16 turbine generators are capable of producing more than 2.4 million kW of electrical power. Ultimately, the powerhouse will have 20 units capable of generating 3.1 million kW. The electricity is sold and distributed by the Bonneville Power Administration. Revenue from the sale of the electricity is used to pay the dam's construction and operating and maintenance costs.

The dam's navigation lock, one of the highest single-lift locks in the world, assists boats and barges to move grain downstream and transport petroleum products and agricultural chemicals inland. The dam created Lake Umatilla, which is 76 mi (122.3 km) long and has a shoreline 240 mi (386.2 km) long. Lake Umatilla has a surface area of 52,000 acres (21,044.4 hectares) and a flood control storage capacity of 500,000 acre-ft (616 Hm^3). The water level of Lake Umatilla at the dam fluctuates between 257 ft (78.3 m) mean sea level (MSL) to 268 ft (81.7 m) MSL. Daily fluctuations at the dam are normally 4 ft (1.2 m) at a rate of .2 ft/hr (6.1 cm/hr). The water level of the lake's headwaters near McNary Dam may fluctuate as much as 3 ft (0.9 m) in 1 or 2 hours, depending on the electrical power demand. Normally the lake level at the dam is maintained between elevations 262 and 265 ft (79.9 and 80.8 m) MSL from October through April. From May through September, the lake level

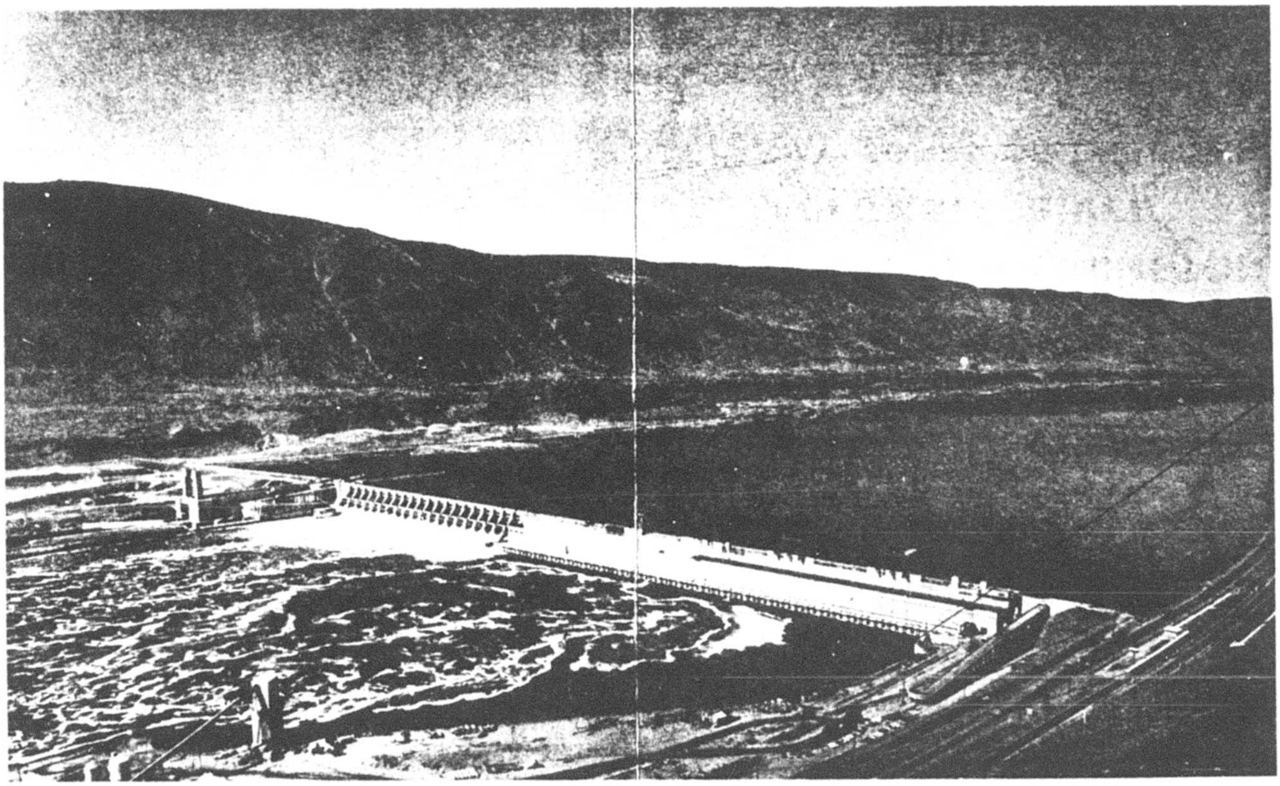

Figure 19. John Day Lock and Dam.

fluctuates between 262 and 268 ft (79.9 and 81.7 m) MSL.

At the dam, the river flows an average of 188,500 cu ft/sec (5337.7 m^3/sec). The minimum recorded flow was approximately 60,800 cu ft/sec (1721.7 m^3/sec), and the maximum was 1,230,000 cu ft/sec (34829.7 m^3/sec).

Sixteen recreational areas are currently associated with the lake, including six boat launching ramps on the Washington Shore and seven on the Oregon shore. A 30,000-acre (12141.0-hectare) National Waterfowl Management Area has been established on the lake to provide a stable habitat for ducks and geese. This area is managed by the U. S. Fish and Wildlife Service in cooperation with state wildlife agencies in Oregon and Washington.

Interstate Highway 80N and tracks for the Union Pacific Railroad parallel the lake's south shoreline in Oregon. State Highway 12 and a track of the Spokane, Portland, and Seattle Railroad parallel the lake's north shoreline in Washington.

Debris

The area surrounding the John Day Dam is dry, and the natural vegetation is grass. Most of the river water originates in the mountains east of the dam. During the freshet period (late May and early June), debris is washed down from the floor of the mountain forests into the Columbia and John Day Rivers.

Much of the debris coming down the John Day River from central Oregon is probably produced by small logging companies improperly disposing of slash.

Most of the debris is limbs and brush; there are very few logs or trees in the debris. Periodically, some debris is washed in from barnyards, including boards, oil drums, and posts.

Natural debris may take 3 to 4 years to reach the dam. During the freshet periods and the lake's daily fluctuations, the debris floats free of the shoreline. As the water level falls, the debris is redeposited, often on the boat ramp or shoreline of a recreational area where it interferes with activities. Some of the debris may float in the lake for 3 to 4 weeks before sinking and working toward the dam.

The wetting and drying process bleaches the wood and removes much of its lignin. The bleached debris is characteristically white, dry, and brittle, and burns rapidly, producing almost no heat and relatively little ash.

Most of the debris is smaller than 6 in. (15.2 cm) in diameter and less than 15 ft (4.6 m) long. Many small twigs and pieces of bark are found with the bigger pieces of debris. Debris solidly lines both banks of the lake from John Day Dam to McNary Dam, a distance of approximately 76 mi (122.3 km). Several large pockets of debris were found on sand bars. Both banks of the John Day River were also lined with debris for several miles.

Since the lake banks are steep, access to the debris from the shore is limited; movement of equipment up the tributaries is restricted by low bridges. Dam personnel remove debris that obstructs boat ramps and becomes beached on the shores of recreational areas, since access to debris in these areas is comparably unrestricted.

Personnel estimate that 3000 cu yd (2293.7 m^3) of debris were removed at the powerhouse and from recreational areas in 1974. This is estimated to be approximately 1 percent of the current total volume of debris in the lake. Dam personnel believe new regulations which state that logging roads cannot be constructed within 50 ft (15.2 m) of a river or stream will reduce the amount of debris coming into the lake.

The estimated cost for the debris removal in 1974 was $60,000. Table 4 shows a breakdown of the estimated expenses for this work for FY74. The average annual cost for debris disposal is estimated to be $1000.

The major problem at the John Day Dam is removal of the debris from the intake face of the powerhouse, rather than disposal. During the freshet period, the dam's spillway gates are open, and much debris is flushed downstream. Debris accumulates at the powerhouse intakes during the remainder of the year when the gates are closed to regulate the water level.

A log boom has been constructed along the intake face of the powerhouse to keep floating debris away from the structure's wall. Periodically, a slack boom is spread between two boats. One boat moves between the debris and the log boom at the structure, pulling the slack boom and encircling the floating debris in a pocket. The boats then move the debris to the disposal area northeast of the dam and the ends of the pocket boom are anchored to the shore. A crane lifts the debris from the water and places it on shore. If the debris is not removed frequently, some of it becomes waterlogged and sinks at the intake face of the powerhouse.

Present Disposal Operation

The disposal area is 1/4 to 1/2 mi (0.4 to 0.8 km) east of the north end of the dam in Washington. This is the only area within the dam vicinity where there is enough flat land adjacent to the water to pile the debris throughout the year. Roads provide access to the area.

Since the summers in this area are very dry, the debris is not burned until there have been at least two rains. The rains usually come in October, and the debris is not burned until November or December.

Table 4

Estimated Cost for Debris Removal* (FY 74)
John Day Dam

Labor:		
1760 man-hours on floating debris		
2200 man-hours on beached debris		
3960 man-hours	Total Est.	$40,000
Additional:		
Equipment - launches, small boats, derrick barge, etc.		20,000
	TOTAL	$60,000

* Additional expenses may have been charged to the operation and maintenance of the recreational areas, rather than debris disposal.

The wood is piled and disposed by unconfined burning; very little smoke or ash is produced by the fire.

The region surrounding the dam is very sparsely populated. It is rural, consisting mostly of grain farming and grazing agriculture. Cattle graze on the steep slopes of the hills that are unsuitable for farming. Dry-land farming practices and irrigation are used extensively throughout the area. Large wheat farms dominate the landscape.

Several small communities are located along the banks of the lake. There has been no adverse public response regarding the removal or disposal operation; however, there have been complaints regarding debris at boat ramps.

The average annual cost for the removal and disposal operations is approximately $61,000; the labor for this operation requires approximately 2 man-years using the present equipment.

Physical Environment

John Day Dam is located in a rain shadow created by the Cascade Mountain Range. Annual area precipitation ranges from 12 to 16 in. (30.5 to 40.6 cm), with most occurring from October through February (approximately 1 to 2 in. [2.5 to 5.1 cm] each month). The average annual surface runoff is 1 in. (2.5 cm).

The Columbia River drainage basin covers 259,000 sq mi (670807.4 km^2) in the United States and 39,700 sq mi (102822.6 km^2) in Canada. The freshet reaches Lake Umatilla in late May and early June. Low stream flow occurs in late summer and fall. The mean average temperature of the area in January is 40°F (4°C). The mean average temperature in July is 80°F (26°C).

The lake and dam are located in the Columbia Basin. Local relief ranges from 1000 to 3000 ft (304.8 to 914.4 m) with 50 to 80 percent of the area gently sloping. More than 75 percent of the gently sloping land is on the upland.

Volcanic bedrock outcrops occur parallel to the Columbia River. The depth of the regional water table averages approximately 600 ft (182.9 m); basalt aquifers are the major source of underground water.

The natural vegetation in the immediate vicinity of the lake is categorized as sagebrush steppe. The area is very dry, and natural grassland occurs in the uncultivated areas adjacent to the lake.

Within the Columbia Basin, the differences in topographic relief may cause the precipitation and temperature, and therefore the natural vegetation, to change within a few miles.

Safety

The main tourist and visitor season is during the summer. Access to the burn area is limited, and personnel can restrict visitor access to the area. Access to recreational areas from major highways is limited, and dam personnel can prohibit access to these areas during cleaning operations.

Precautions are taken to insure worker safety during cleaning and disposal operations.

Environmental Considerations

The burn site is located on government property managed by the Corps.

Several small communities are located near the lake shoreline. Rufus, OR, approximately 3 mi (4.8 km) southwest of the dam is closest to the burn site. The climate of the area is quite arid; residents of nearby communities must water trees, lawns, and gardens extensively. There are several large-scale commercial irrigation projects in the area for production of grain, fodder crops, and fruit. Deep wells and the Columbia River are sources of irrigation water. The area adjacent to the dam is sparsely populated, and disposal of the debris at the burn site does not affect adjacent land use.

Very little residue is produced by burning the debris; wind and rain remove most of the ash from the site. No tests have been conducted to determine the effect of the residue on air or water quality.

No adverse effects to the environment have been associated with the noise, shock, or vibration produced by removal and disposal operations.

Legal Considerations

There are currently no known laws in Washington which regulate or prohibit unconfined burning. However, two of the management personnel for John Day Dam believe that both Oregon and Washington may prohibit unconfined burning in the future.

Oregon has a number of environmental regulating agencies; most of these are located in the Willamette River Valley, where approximately 1.5 million people, or 50 percent of Oregon's population, reside. Laws have also been applied in other areas of Oregon.

Pressure is currently being applied to prohibit all unconfined burning. In the Pacific Northwest, burning has been a standard farming practice for years; in Oregon, several state laws are creating many problems for agricultural industries. Figure 20 is an article from *The Oregonian* regarding burning legislation.

Oregon legislation has closed dumps and restricted disposal to landfills which are now being developed throughout the state. Presently, Washington environmental laws are considered to be more lenient; however, if current legislative trends continue, unconfined burning will be regulated and possibly prohibited in the future.

Economic Considerations

Most of the debris removed from Lake Umatilla is unsuitable for processing. There are no markets for the wood debris in the immediate vicinity of the John Day Dam, due to its remote location, the low population density of the area, and lack of proximity to wood industries.

A chipping plant at The Dalles, OR, approximately 30 mi (48.3 km) downstream from the John Day Dam, may provide a market for the debris

Continued field burning wins vote

By HARRY BODINE
of The Oregonian staff

SALEM — The Oregon Senate voted Monday to allow open field burning to continue in the Willamette Valley.

Senate Bill 311 passed 19-11. The measure goes to the House.

Senate Agriculture and Natural Resources Committee Chairman Mike Thorne, D-Pendleton, said there is no substitute available for open field burning to control weed problems in Willamette Valley grass seed fields.

The committee was not able to establish "facts" on claims by Eugene area residents and physicians that field burning constituted a health hazard, Thorne said.

Sen. George Wingard, R-Eugene, moved to send SB 311 back to committee, noting that the measure allowed open burning on 90,000 acres in the Willamette Valley in 1978 and later years.

He said fees in SB 311 assessed against grass seed growers for research were not high enough. Fees should be assessed on a yield basis, rather than acreage basis, he contended.

Wingard said the Legislature was not asking the grass seed industry to do anything more than it has asked other industries to do in cleaning up pollution.

Sen. Thorne said SB 311 wipes out the ban on open field burning that took effect Jan. 1.

The bill gradually phases down the acreage that can be burned over a four-year period to 35 per cent of 1974 levels by 1978.

It also directs that research into alternate methods of weed and disease control for the grass seed industry be continued by the Oregon Field Sanitation Committee, a group similar to the Field Burning Committee established in 1971.

Thorne said growers (who paid $1 an acre last year) would face greater assessments ranging up to $4 an acre for all acres burned in 1978, plus a 50-cent an acre smoke management fee and an additional $1 an acre for research applied to all grass seed acres in 1975-76, regardless of how they are sanitized.

The Eugene area, recipient of most field burning smoke in recent years, has fought to keep the 1971-mandated ban in effect. The grass seed industry, claiming the ban would cripple the industry, is eager to continue open burning.

Opposing SB 311 on final passage were: Democrats Walter Brown, Betty Browne, Burbridge, Fadeley, Hallock, McCoy, Betty Roberts, Frank Roberts, Mary Roberts, Whipple; Republican Wingard.

Figure 20. Newspaper article on burning legislation in Oregon. From *The Oregonian*, April 8, 1975.

if its quality improves or methods are developed to use it at its present quality.

There is no landfill or other disposal site located near the John Day Dam; in the future, one will probably be established. This could provide an alternative for debris disposal.

Analysis (John Day Dam)

Five alternative means of debris disposal were analyzed.

1. Placement of the debris on the ground for decomposition. The wood would probably decompose very slowly in the arid climate. Consequently, a large pile would soon accumulate, since the present disposal area is not large enough to accommodate the amount disposed. The Corps does not manage any areas near the dam suitable for this alternative. Other land is privately owned and used for agriculture.

2. Burial of the debris with or without processing to reduce the volume. There is currently no suitable area in the dam vicinity for debris burial; in the future, a sanitary landfill may be established in the area.

Since a large volume of debris is removed from the lake each year, the amount would reduce the longevity of a landfill quite rapidly. A private landfill operator would have to charge the Corps for burial of the debris. The transportation expenses, dumping fee, and other costs would have to be considered in determining the economic feasibility of this alternative. For example, the debris might have to be chipped before the landfill operator would accept it.

3. Selling the debris with no processing. Future demands for wood products may create a demand for the quality of wood that is presently removed from Lake Umatilla; however, there is no market for the debris in the dam vicinity at this time.

4. Processing the debris for sale as mulch, firewood, etc. There is no market for the processed debris in the vicinity of the dam.

The debris could be used to produce mulch for placement around the trees in the recreational areas managed by the Corps to reduce moisture evaporation; however, labor, transportation, and equipment costs or rental fees associated with this operation would not justify the product's limited use.

5. Confined or unconfined burning of the debris. Unconfined burning is currently used to dispose of debris. Although there are no known state statutes in Washington which prohibit or regulate the unconfined burning operations such laws may be enacted in the future.

A pit incinerator could be established at the present burn site.

The pit would have to be lined, since the site is composed of loose sand and gravel. A railroad boxcar would provide an excellent liner at a relatively inexpensive price. (The current price for a boxcar ranges from $250 to $550.) Interstate 80N or Washington State Highway 12 could provide truck access to the site.

The portable ACD-42 or a comparable model blower could be used. This blower and a 40-ft (12.2-m) boxcar would provide a large burning capacity; if the amount of debris increases, this equipment could accommodate the extra amount at maximum efficiency. A portable ACD-42 with a gasoline engine costs approximately $17,345, including the $1428 delivery fee. Local manufacturers may sell a comparable model at less cost.

The truck-mounted crane presently used at the site to move the debris would be sufficient for charging the pit.

Conclusions for John Day Dam

The unconfined burning operations now conducted at John Day Dam do not violate any known laws or regulations in the state of Washington. If legislation to prohibit unconfined burning is enacted, the project engineer and resource manager should consider the following alternatives:

1. Placement of the debris on the ground for decomposition. This option is not available since there is not enough suitable land.

2. Burial of the debris with or without processing to reduce its volume. At this time, no site is available for debris burial.

3. Selling the debris with no processing. The dam is located in a remote region where there is no market for the debris.

4. Processing the debris for sale as mulch, firewood, etc. There is no market for the debris in the immediate vicinity of the dam. The market price for the processed debris would have to be high enough to justify processing and transportation costs.

5. Confined burning of the debris. At present, it would cost approximately $20,000 to establish a pit incinerator at the burn site. The portable blower could be moved to other dams to dispose of debris, but limited burn seasons could restrict the extent to which a blower could be used at other sites. Most Oregon burning regulations approve the use of air curtain (pit) incinerators, if there are no feasible or practical alternatives to this form of confined burning. The regulating agencies usually establish visible emission standards for the operation of an air curtain (pit) incinerator.

Recommendations for John Day Dam

COE personnel at John Day Dam should continue to use unconfined burning to dispose of debris as long as it does not violate burning laws or regulations, since it is one of the cheapest disposal methods.

If future state legislation prohibits open burning, a confined burning operation should be established at the disposal site, provided use of a pit incinerator is not prohibited also. If a landfill site is established near the dam in the future, Corps personnel should consider the economic feasibility of burial. Other disposal methods should also be reviewed periodically for possible improved economic feasibility. When economically possible, COE personnel should try to use the debris in some manner, rather than eliminating it by burning.

The major problem presented by floating debris at the John Day Dam is its removal. A detailed survey should be conducted to determine the debris' major sources; the Corps should then try to prevent the debris from leaving these areas and entering the lake's tributaries. In addition, a detailed study should be conducted to determine major areas of debris accumulation in the lake. Disposal sites should then be located along the Washington shoreline of these areas.

The debris could be moved to the nearest disposal site by the same methods used to move it from the face of the powerhouse. During high-water periods, boats could encircle the floating debris with a slack boom and move it to the selected disposal site. Here, a crane could remove it from the water and pile it for burning. The lake level could be elevated by the dam at an established time to insure that the boats are ready to encircle the debris. This operation could be conducted by COE personnel or contracted to a private firm.

Neither of these methods can be considered a panacea to the problem; however, if the Corps is able to retain the debris in the source area and if removal operations are conducted in the major accumulation areas, the total amount of debris in the lake should be reduced considerably after a relatively short time.

Another possibility is to construct log booms across the lake's tributaries to prevent floating debris from entering the lake. The debris could then be removed periodically and disposed in an acceptable manner. No acceptable sites for constructing log booms were located in this study, although not all areas were investigated.

Franklin Falls Dam, NH

Description

Franklin Falls Dam was visited during the week of 21 April 1975. It is constructed across the Pemigewasset River near Franklin, NH.

Figure 21 is a photograph of the downstream side of the dam from its west end with the spillway in the foreground. The outflow channel is located at the approximate center of the dam. The total length of the dam is 1740 ft (530.4 m).

The dam creates a reservoir that is approximately 13 mi (20.9 km) long and has a maximum water capacity of 154,000 acre-feet (190.0 Hm^3). The reservoir shoreline is approximately 26 mi (41.8 km) long; the dam's watershed covers 1000 sq mi (2590.0 km^2). Franklin Falls is the first in the series of dams removing debris from the river.

The water level of the reservoir is kept as low as possible throughout the year to maintain a maximum storage capacity for floodwater.

This dam, one of several used to control the floodwaters in the Merrimack River Basin, was designed to protect the downstream areas of New Hampshire and Massachusetts from flood damage.

Recreational facilities available at the site include picnic areas and hiking trails.

Access to the reservoir is limited on the east side of the river valley. Near the east end of the dam, a dirt road provides access to the log boom and burn site. An abandoned, hard-surface road which parallels the west bank of the reservoir for approximately 10 mi (16.1 km) provides access to the floodplain west of the river.

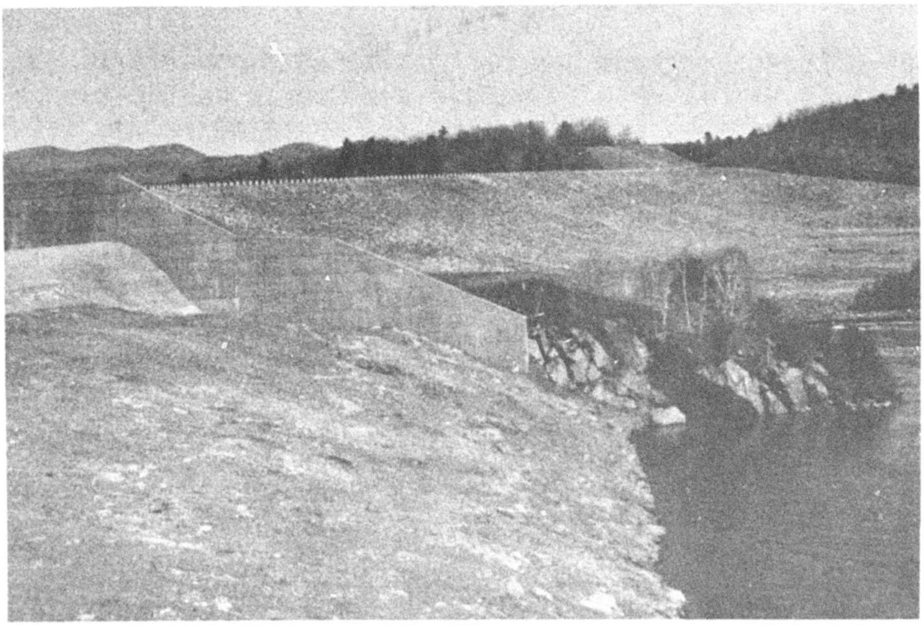

Figure 21. Franklin Falls Dam.

Debris

Most debris found in Franklin Falls Dam comes down the Pemigewasset River during the spring freshet, or during infrequent unseasonably large amounts of precipitation in the summer or fall.

Wood debris originates from the forest floors. During the winter, ice and snow break off trees and branches of trees near the stream bank; these are carried by the high water into the reservoir. North of the dam in the floodplain are large areas of dead trees; when these fall, the high water carries them downstream to the dam (Figure 22).

Another source of debris is the trash thrown into the water by people living along the river. The high water carries this debris into the reservoir.

Debris found in the reservoir includes tree stumps, tree branches, tree trunks, tires, oil drums, plastic bottles, signs from recreational areas in the White Mountains, the floor from a burned covered bridge, and concrete forms from an interstate highway. Most of the debris, however, is forest wood in various stages of decomposition (Figure 23).

In 1973, there were approximately 75 acre-feet (0.1 Hm^3) of debris in the reservoir.

A log boom, constructed across the reservoir just north of the dam (Figure 24) is anchored on each bank. The east anchor is positioned farther downstream so the log boom is held at an angle toward the southeast corner of the reservoir. During periods of highwater, floating debris is forced into the southeast corner of the reservoir by the moving water; as the pool level drops, the debris is deposited on the bank, where it is piled and burned. Sometimes a second log boom is used to hold the floating debris in place so that the wind does not push it to another location.

If the debris remains behind the log boom in the river channel for a long period of time, it sinks and moves downstream into the intakes at the outflow tower. If this occurs, the project manager must periodically hire a contractor to remove the sunken debris from the river channel (Figure 25).

Construction of another log boom closer to the dam is planned so that the floating debris will be caught if the main log boom breaks. This log boom would be shorter and would protect only the intakes of the outflow tower from floating debris.

Most reservoirs in the New England Division use log booms to catch floating debris. The logs in the booms are joined by chains, which cost approximately \$25 apiece. These chains are connected to 1-in. (2.5 cm) steel cables (Figure 26) which prevent the chains from pulling through the ends of the logs. The cable costs approximately \$2/ft (\$6.56/m).

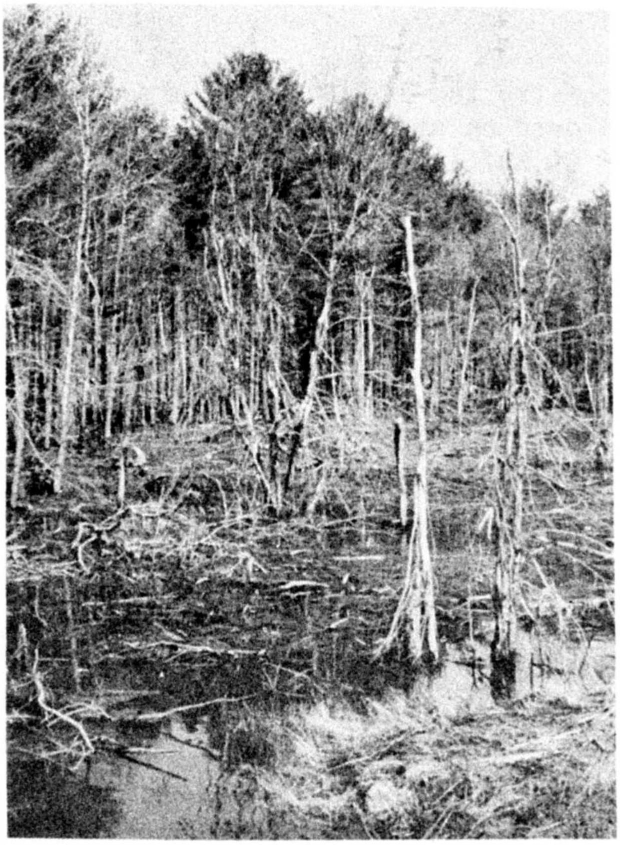

Figure 22. Dead trees in floodplain at Franklin Falls Dam.

Figure 23. Debris at Franklin Falls Dam.

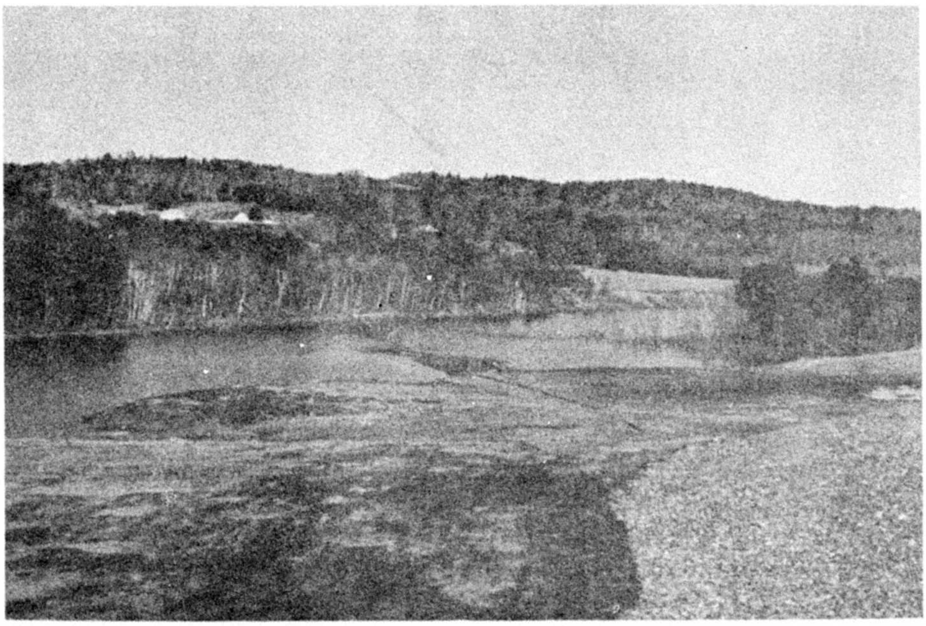

Figure 24. Log boom at Franklin Falls Dam.

The logs must be treated to prevent them from decaying. Logs treated with creosote are too heavy and do not float high enough to block the floating debris. Logs that are pressure-treated with the wood preservative PENTA float high and resist decay. In the Franklin, NH area, logs 15 to 18 in. (38.1 to 45.7 cm) in diameter and 18 to 22 ft (5.9 to 6.7 m) long that have been pressure-treated with PENTA cost approximately $50 each. At current area prices, the materials to construct a log boom would cost approximately $115/20 ft ($115/6.1 m).

A tractor-mounted, front-end loader with a forked apparatus is used to pile the debris at the burn site. If a large amount of debris has accumulated, a contractor is hired to move it with a dozer.

Present Disposal Method

Open burning is presently used to dispose of the debris. The burn site is a sandy area at the east end of the log boom (Figures 24 and 27). The nearest dwellings, buildings, and highways are approximately 1 mi (1.6 km) from the burn site. Franklin, NH, is approximately 2 mi (3.2 km) from the disposal site. The area near the site is characterized by small farms, woodlands, and forest with some crop land and pasture. There has not been any negative public response to the unconfined burning operation.

Removal and burning operations are conducted several times during the spring season. It takes approximately 13 days to drop the pool so that the debris can be deposited on the ground. Small pieces of debris often reach the upstream face of the dam, but most is held by the log boom.

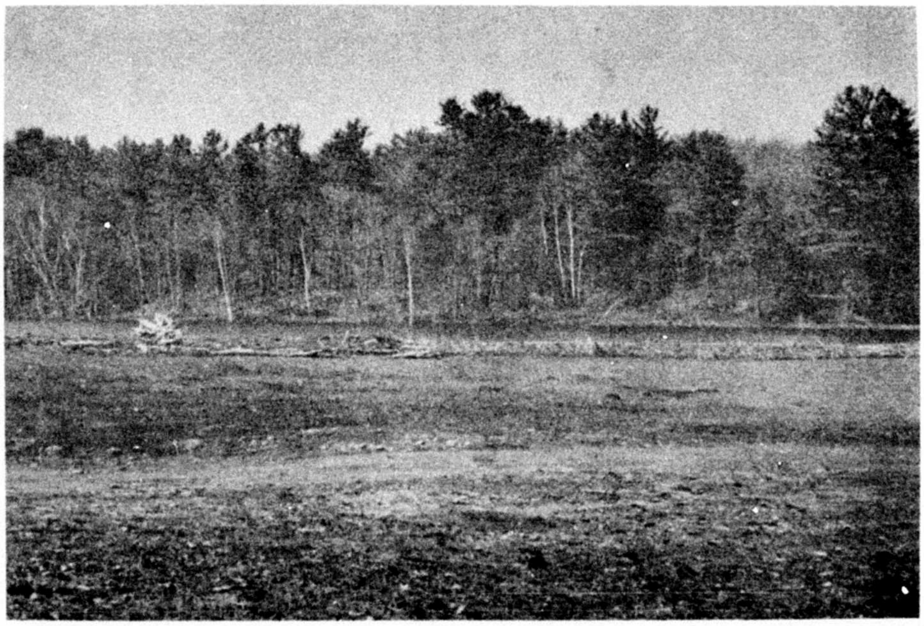

Figure 25. Debris evident at lower water level at Franklin Falls Dam.

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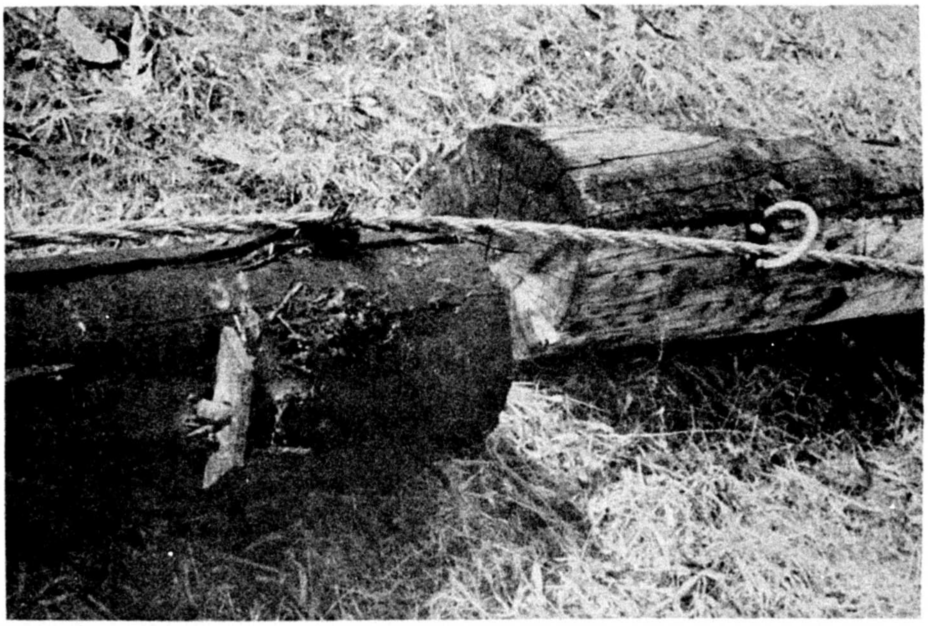

b

Figure 26. Log boom connector.

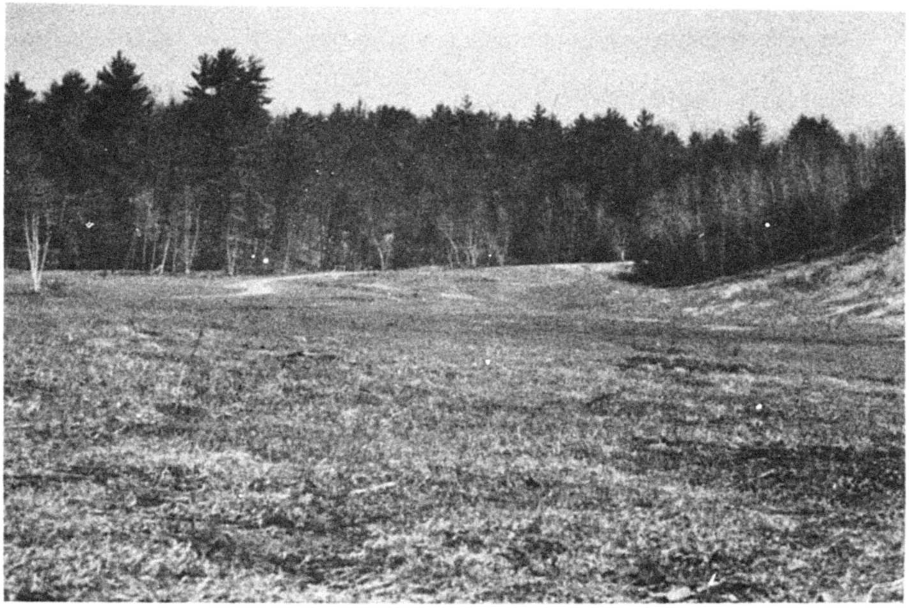

Figure 27. Burn site at Franklin Falls Dam.

The project manager and two laborers are employed fulltime at the dam. Additional laborers are hired during summer months. The average annual cost for removal and disposal of debris is $10,000.

The dam has a chipper (Figure 28) capable of chipping wood 6 in. (15.2 cm) in diameter, which is used to chip brush and limbs during reservoir clearing. Chipping the wood debris from the reservoir with this machine proved to be very unsatisfactory.

Physical Environment

The Franklin Falls Dam is located in the Adirondack-New England Highlands. The area is 20 to 25 percent gently sloping, with 50 to 75 percent of the gently sloping area in the lowlands. Local relief is 1000 to 3000 ft (304.8 to 914.4 m).

Coniferous forest containing mostly white, red, and jack pine is the dominant vegetation in the area.

The mean January temperature of the area is 20°F (-7°C) and the mean July temperature is 70°F (21°C). Average annual precipitation is 40 in. (101.6 cm) with approximately 6 in. (15.2 cm) occurring during November. Precipitation for the remaining months ranges from 2 to 4 in. (5.1 to 10.2 cm). The area receives 60 to 80 in. (152.4 to 203.2 cm)

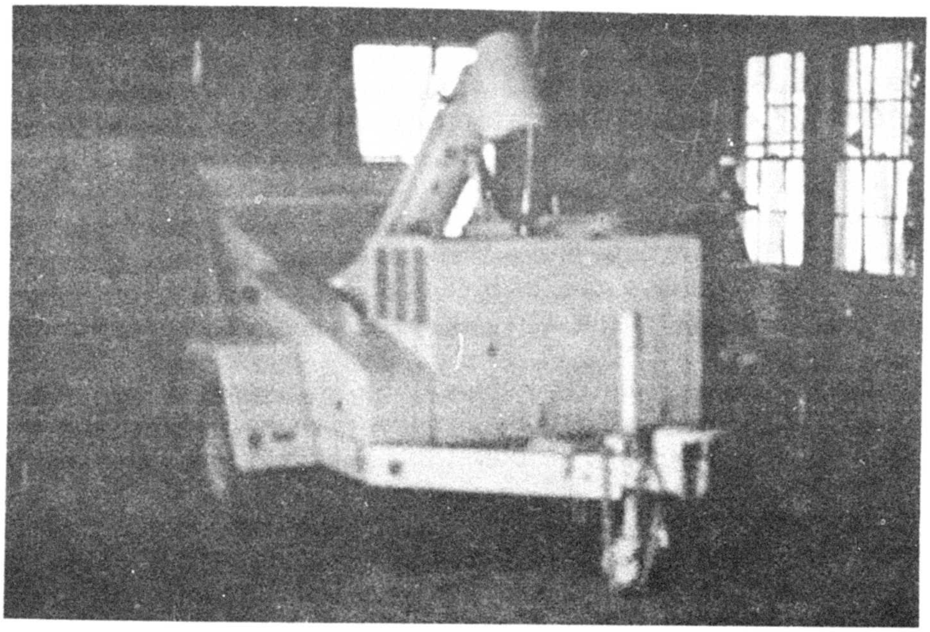

Figure 28. Chipper.

of snowfall each winter. The average annual surface runoff is 25 in. (63.5 cm) with approximately 40 percent occurring in April and May. August is characterized by the lowest stream flow, and April has the highest.

Bedrock outcrops, most of which are igneous, occur throughout the area. The water table is near the surface of the floodplain, and consolidated sand and gravel aquifers are located in the floodplain. The river recharges these aquifers.

All of the area was glaciated in recent geologic time. This action stripped the soil from the bedrock and deposited large amounts of sand and gravel throughout the area.

Safety

The dam area contains many lakes and recreational facilities, and summer homes are located along the shorelines of the lakes. The population of communities surrounding the reservoir doubles or triples during the summer months.

The burn site is located within the boundaries of property managed by the Corps of Engineers so that public access to the site can be completely controlled.

Environmental Considerations

The Corps manages the land adjacent to the disposal site. The site location prevents burning operations from conflicting with adjacent land uses.

The burn area is inundated during high-water periods. Residue from the burning operation may cause some water pollution, but the vast quantity of water causes the dilution factor to be high. No tests have been conducted to determine the degree of residue concentration.

The burning operation releases some pollutants into the atmosphere; however, no tests have been conducted yet to determine the type of emissions or their concentrations in the outlying areas.

The equipment used to pile the debris emits some noise, but no tests have been conducted to determine the noise level affecting the workers. It is assumed that the equipment will meet the Occupational Safety and Health Act (OSHA) standards.

No tests have been conducted at the site to determine the effects of shock or vibration caused by the equipment.

Legal Considerations

The project manager obtains a permit from the local fire department before conducting any burning operation at the dam. There are no known laws prohibiting unconfined burning at the dam.

Economic Considerations

There is no market for the debris in the immediate dam area. The majority of the debris is wood in various stages of decomposition. Corps personnel salvage most of the usable items found in the debris, such as boards and oil drums, for use at the dam. No market can be expected in the future for the debris due to its poor quality and the available timber in the adjacent uplands.

Since the Forestry Service allows area residents to cut firewood from forests on the surrounding mountains, there is no market for firewood.

The present burning operation eliminates the debris at the site with a minimum of handling. The actual costs vary because of the various removal techniques used. When contractors are hired to assist with removal and/or dispcsal, the costs are expected to be higher. The average annual cost for the removal operation is estimated to be $5000, and the average annual cost for disposal is estimated to be $5000.

Analysis (Franklin Falls Dam)

Five alternatives for disposing of the debris were analyzed.

1. Placement of the debris on the ground for decomposition. There are no suitable areas where such a large volume of debris can be placed and allowed to rot. Most flat, cleared areas are used for agriculture. Placement of debris in the mountains is not feasible, since it would create a fire hazard or insect problem and because there is no easy access to the areas.

2. Burial of the debris with or without processing to reduce its volume. There are few landfill sites in the area. The large volume of debris that would have to be buried each year would soon fill a landfill site, so it is doubtful that landfill owners would accept the debris.

3. Selling the debris with no processing. The majority of the debris is of very poor quality and is in various stages of decomposition. Very few products could be produced from such wood with current technology, and there is no area market for the debris.

4. Processing the debris for sale as mulch, firewood, etc. Most of the debris is unsuitable for firewood. The debris could be processed for mulch, but there is no local market for it. In addition, it would be expensive to separate usable wood from the rotten debris.

During the winter of 1973-74, the price for a cord of good quality, seasoned firewood ranged from $100 to $120 in Boston, approximately 80 mi (128.7 km) from Franklin Falls Dam. However, most of the debris arrives in the spring, and the major demand for firewood is in the fall and winter. If debris quality improves and the price for firewood remains high, a private contractor might be encouraged to remove the better wood, cut it, and store it for later sale in the urban markets. However, since the debris quantity and quality vary annually, buyers or contractors are unwilling to buy it. In addition, the times that debris would be available for sale would not be consistent, since various factors change the time when the debris appears at the dam or when it can be picked up at the disposal site.

5. Confined or unconfined burning of the debris. Unconfined burning is presently used to dispose of the debris at an average annual cost of approximately $5000.

A pit incinerator could be constructed at the present disposal site to provide a confined burning disposal method. The tractor-mounted, front-end loader could be used to charge the pit; however, a forked lifting device should be used instead of a bucket to allow dirt on the debris to fall through the tines. It would be necessary to hire a contractor periodically to use a dozer or crane to charge the pit with large debris that the tractor could not handle. The front-end loader should charge the pit from behind the blower to prevent driving the tractor into the pit or dumping debris on the blower.

Several removal and disposal operations are necessary to prevent debris from accumulating at the dam. Each time that high water occurs, more debris accumulates at the log boom. It requires approximately 13 days to drop the pool under normal high-water conditions; consequently, the debris should be disposed as soon as possible after the pool is dropped before another high water period occurs.

Piling and burning all the debris at one time is a fast disposal method between high-water periods. The burning capacity of a pit incinerator depends on a number of variables, but a larger pit will generally have a greater potential burning capacity.

The present disposal site is sandy, so the pit walls would have to be lined to prevent them from collapsing. A standard-sized railroad boxcar would provide an excellent pit liner at minimum cost. After the pit has been inundated by floodwaters, excess dirt should be removed from the bottom of the pit to increase the burning capacity. Dirt should also be removed from the metal sides of the car to allow heat dissipation and prevent the car sides from buckling.

The depth of the pit may be restricted at the disposal site by a high water table. The pit should be excavated as deeply as possible above the water table. If the pit is not deep enough to permit the railroad car to be buried up to the top, a dirt ramp may be constructed on one side to support the blower and provide access to the pit for the charging equipment.

A portable blower should be used so that it could be removed easily prior to periods of inundation. In addition, a portable blower could be used at other dam sites.

The ACD-42 or a comparable model should be used with a 40-ft (12.2-m) pit to achieve maximum burning capacity. The approximate cost of an ACD-42 with gasoline engine is $15,917. The cost for having the ACD delivered from Attica, IN to Franklin, NH would be approximately $748.

Conclusions for Franklin Falls Dam

The project manager has five alternatives for disposing of the cleaning debris at Franklin Falls Dam should unconfined burning be prohibited.

1. Placement of the debris on the ground for decomposition. This alternative is not currently open, because there are no suitable places available within the dam vicinity.

2. Burial of the debris with or without processing to reduce its volume. There are no suitable areas within the vicinity of the dam to bury the debris.

3. Selling the debris with no processing. No markets are available in the dam area.

4. Processing the debris for sale as mulch, firewood, etc. At this time, there is no market for processed debris in the dam area. The poor quality of most of the debris restricts the number of potential markets where it could be sold after processing.

5. Confined burning of the debris. Pit incineration is now the only alternative if future laws prohibit unconfined burning. At current prices, the cost of constructing a pit incinerator would be approximately $18,500.

Recommendations for Franklin Falls Dam

The study indicates that the cheapest disposal method at this time is unconfined burning of the debris. In the future, it may be more economically feasible to acquire a truck-mounted crane than to pay a contractor to clean the river channel. The crane could also be used to pile the debris for burning or to charge a pit incinerator.

If future laws prohibit unconfined burning at the dam site, a pit incinerator should be constructed to dispose of the debris, provided the use of a pit incinerator is not also prohibited.

The project manager should continue to check potential markets for the debris to determine whether the market price will cover processing and/or transportation costs.

Summary of Other Site Visits

Investigators visited four other dams located in the vicinity of the four sites discussed previously. These visits are summarized below. Jones Bluff Lock and Dam is located across the Alabama River 15 mi (24.1 km) southeast of Selma, AL and lies on a northwest-southeast axis. From left to right in Figure 29, its structures are an earth dike, a powerhouse presently under construction, a gated spillway, the lock, and an earth dike. The resource manager has stated that no floating debris has been removed at the powerhouse construction site; it has been flushed downstream through the spillway gates or the lock. The Jones Bluff Lock and Dam is a multipurpose structure which will provide the area with navigation, power, and recreational benefits.

The Dalles Dam, a multi-purpose structure similar to the John Day Dam, is located across the Columbia River approximately 1 mi (1.6 km) east of The Dalles, OR. The project engineer indicated there is no problem with floating debris at the dam. The powerhouse is constructed parallel to the course of the Columbia River (Figure 30). When the spillway gates are closed and power is being generated, debris sometimes accumulates at the powerhouse intakes; it is removed and flushed downstream by opening the spillway gates. The water passing the powerhouse intakes through the spillway gates sweeps the debris away. Some of the debris is flushed downstream through the dam's trash sluiceway. The estimated average annual cost for flushing the floating debris is $500.

The Green Peter-Foster Project, located near Foster, OR, is one of the Corps multipurpose dam projects located in the Willamette Valley (Figure 31). The two dams of the project are located in the headwaters of the South Santiam River. The area receives 80 to 100 in. (203.2 to 254.0 cm) of precipitation each year and is heavily forested and mountainous. Logging operations are conducted in the mountains surrounding the project. Local income is from forestry or tourism.

Three log booms are located on the Green Peter lake. One is north of the Whitecomb Creek Park across Quartzville Creek in Section 29, one is across the Middle Santiam River east of Tally Creek in Section 34, and the third is upstream from Green Peter Dam in Section 10 (Figure 31).

The log booms across the tributaries prevent floating debris from entering the main portion of the lake. They extend across the water but have an opening for boat passage (Figure 32). Cables link the logs and anchor the log boom to the lake floor. Once a year, two boats and a log boom are used to move the debris to an area where a truck-mounted crane piles it on the bank. When the debris dries, it is burned.

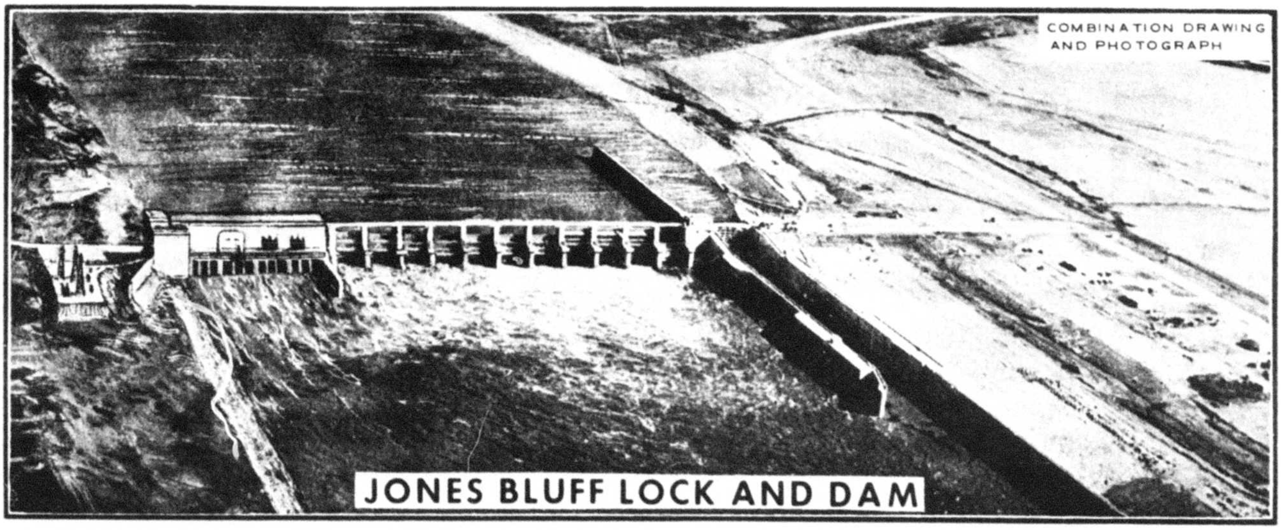

Figure 29. Jones Bluff Lock and Dam.

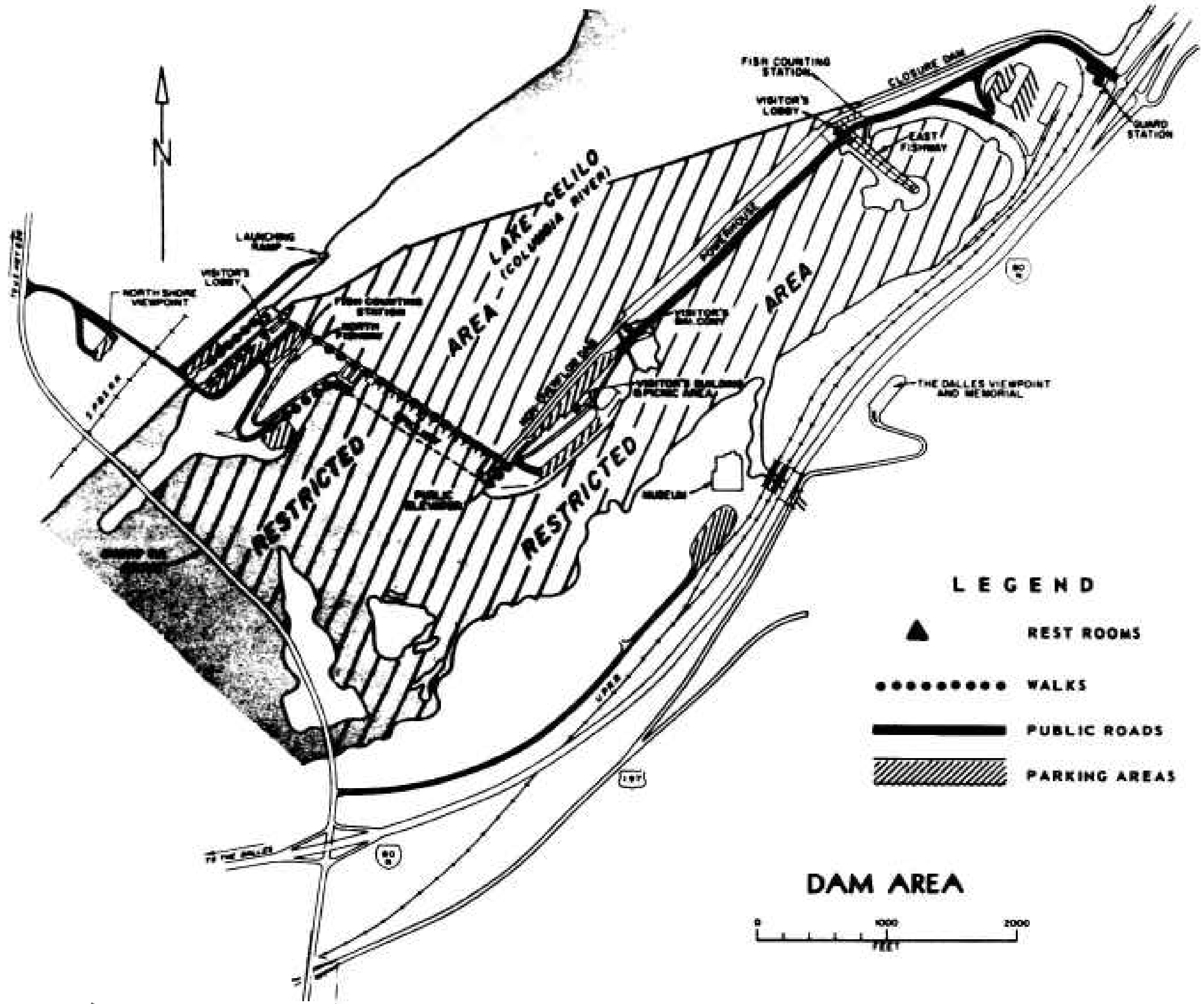

Figure 30. The Dalles Dam.

RECREATION FACILITIES

FOSTER LAKE:

Gedney Creek Access .... Boat launch with parking for cars with boat trailers, boat dock and pit toilets.

Lewis Creek Park .... Day use area with picnic area, comfort stations, boat dock, swimming area and parking areas.

Sunnyside Park .... Overnight camping facilities, picnic area, three-lane boat launch with parking for cars with boat trailers and parking area for picnic facilities.

GREEN PETER LAKE:

Thistle Creek Boat Access ... Two lane boat launch with parking area and pit toilets.

Whitcomb Creek Park .... Overnight camping facilities, picnic area and boat launch with dock.

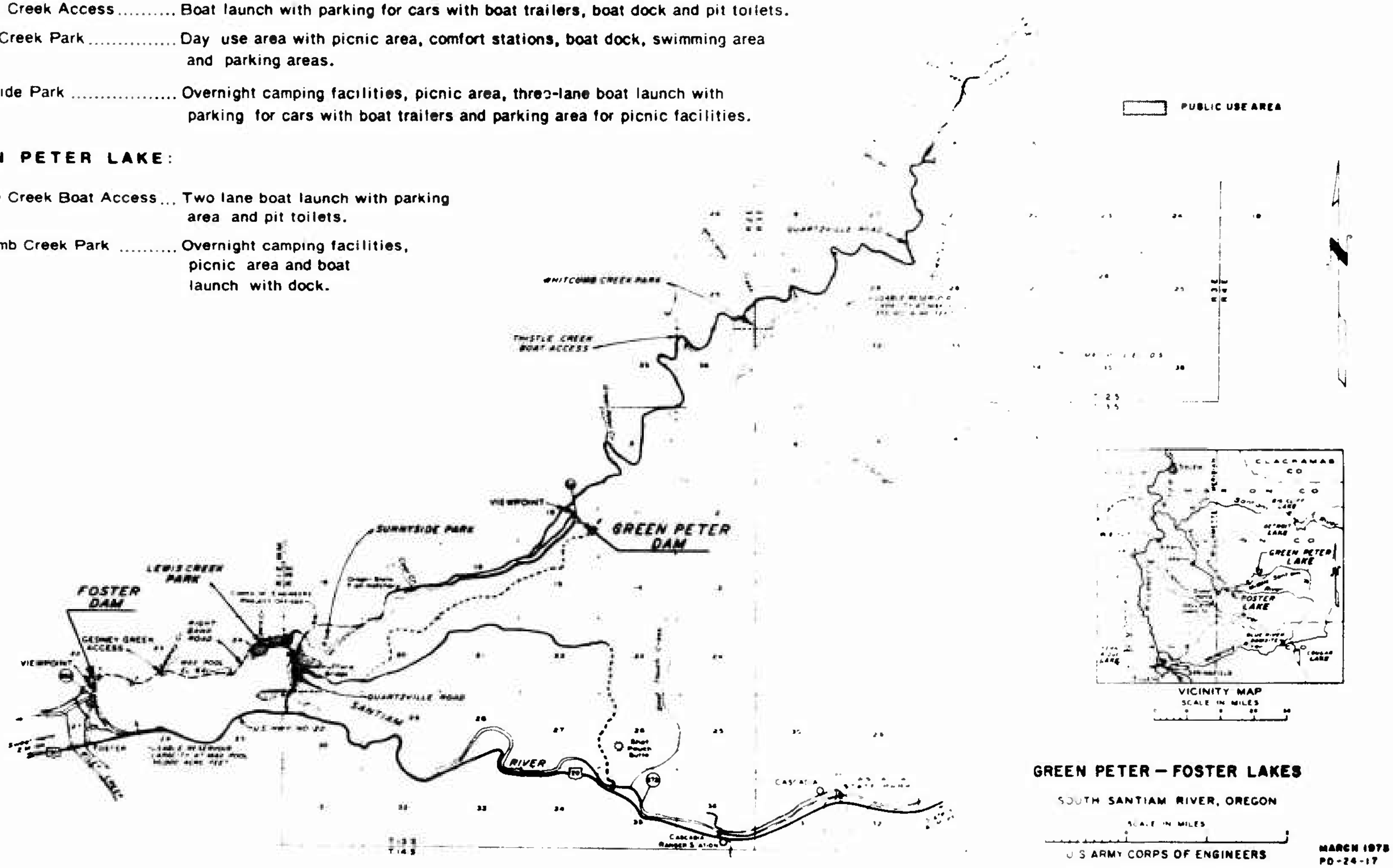

Figure 31. Green Peter - Foster Project area.

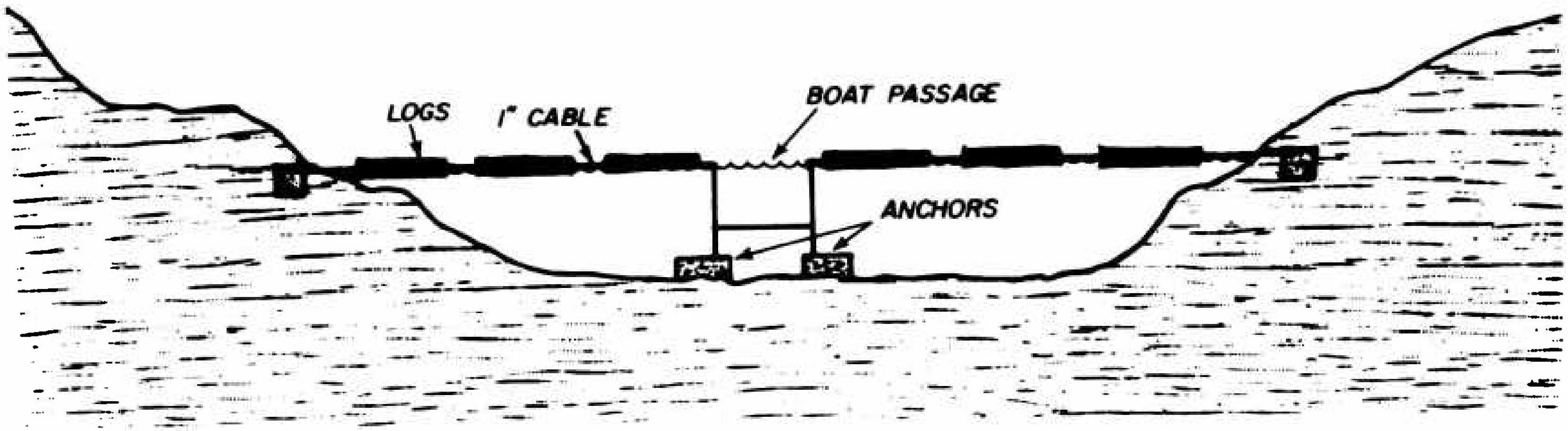

Figure 32. Log boom with boat passage.

The log boom at Green Peter Dam prevents floating debris from reaching the face of the dam structure, but has no opening for boat passage, thereby keeping boats a safe distance from the dam. Once a year, debris is moved by a pocket boom to shore, where the crane piles it for burning. Large logs are saved for use in the log booms.

There is one log boom on Foster Lake, located across the Santiam River west of the Quartsville Road near U. S. Highway No. 20 (Figure 31). The boom has an opening for boat passage similar to the one illustrated in Figure 32. During the winter when the pool is low, the crane or a rented dozer piles the debris on an abandoned road bed. Area residents can then select wood, cut it, and haul it away. The remainder is burned at the site.

In 1972, some logs from the debris were sold, but the money received did not pay for the paperwork necessary for the sale. Bidders will not pay much for the logs because the quality is inconsistent. Most of the wood is not acceptable for lumber. In 1974, when there was a good market for wood chips, many people came to look at the debris but did not buy it. The closest chipping plant is 40 mi (64.4 km) away at Eugene, OR.

The average annual cost for removing floating debris at the project is $20,000 and the average annual cost for its disposal is $2000.

Permits are necessary to burn the debris; in addition unconfined burning in this area of Oregon is restricted to a regulated burn season.

Pit incinerators are acceptable for debris disposal but the areas surrounding the lakes are characterized by steep slopes and shallow soil depth which are not conducive for pit excavation. Access to the water is also restricted by the steep banks, especially at Green Peter Lake.

Although the investigator did not survey the entire area, he did observe two sites where pit incinerators could be established near the lakes.

The engineer for this project also manages Detroit Dam and Big Cliff Dam on the North Santiam River. On 15 February 1975, wood debris was burned at the Detroit Dam. Although the project engineer had obtained a burn permit and had taken the necessary fire prevention measures, a dispute regarding the burning operation arose between regulating agencies with overlapping jurisdictions. Appendix B provides correspondence between the project engineer and the regulating agencies which illustrates the problems that may be generated by conflicts between debris disposal practices and environmental laws and regulating agencies. There will undoubtedly be problems associated with the legal interpretation of environmental laws and the jurisdiction of the regulating agencies in other areas as well.

3 CONCLUSIONS

1. The quality and quantity of cleaning debris is not consistent for one impoundment or a group of impoundments. At most impoundments, debris quality is not suitable for lumber or paper, but some wood debris is suitable for firewood or mulch. However, sorting acceptable debris for processing would increase disposal costs considerably.

Most wood debris is in various stages of decomposition and will not chip well. It is difficult to find a market for the debris, because its quality and quantity vary greatly from year to year. As the demand for wood products increases, substitutes for wood products will be produced, or new technology to process lower quality wood will be developed. If this occurs, wood debris might become marketable. If shortages of raw materials occur in other segments of the economy, the debris might be used as a substitute.

Most impoundments managed by the Corps are distant from potential markets, and processing and transporting costs are expected to increase in the future. Consequently, to be profitable to a contractor, the market price for the debris would have to be high enough to offset these costs.

2. There is no universal method to collect, remove, and dispose of debris at COE impoundments economically. When considering the five disposal methods, the project manager must determine the most economically feasible, legal alternative. In most cases, the most expensive methods of debris disposal are burial in a landfill and chipping; however, one of these alternatives may occasionally be the most economically feasible disposal method compared to the other alternatives, depending on local conditions.

Each dam and impoundment must be analyzed separately or with impoundments in the immediate area, since conclusions for an impoundment in one physiographic region do not necessarily apply to impoundments in other regions. Sites may be grouped by similarities in physical environment, economic conditions, and/or legal considerations, rather than by COE Division or District boundaries. Preferably, dams and impoundments should be grouped by watersheds to evaluate the effect of floating debris on the entire waterway network.

3. It is difficult to compare removal and disposal costs at different impoundments in order to determine an optimum disposal method. For example, one project manager may consider a certain activity to be a part of the removal operation while another manager considers it a part of the disposal operation or an entirely different operation.

The results of the questionnaire submitted to Division offices in 1974 indicated that more money is being spent on removal operations than on disposal operations because the majority of project managers are disposing of the debris by unconfined burning. According to the results of the questionnaire, an estimated $1.4 million is spent annually on removal operations and an estimated $0.4 million is spent annually on debris disposal. If unconfined burning is prohibited by environmental laws, disposal costs can be expected to increase substantially.

Pit incineration will provide the project manager with a relatively inexpensive disposal method, if environmental laws do not also prohibit it. For a moderate equipment investment, the project manager can minimize operating cost increases.

In the future, the pit incinerator may be approved for disposal of trash from recreational areas, thus distributing equipment costs over many operations. Another way to minimize the equipment investment is to use the same equipment at several dam sites. Impoundments in areas having restricted seasons for burning may not be able to use such a plan, because there may not be enough time to complete the burning at all project sites.

4. In certain areas of the country it may be possible to reduce the amount of debris entering the reservoirs by constructing log booms across the tributaries. This method would confine the debris to a smaller area and make removal and disposal operations easier. In addition, it would reduce the amount of debris interfering with activities associated with the main impoundment, such as power generation, recreational activities, etc.

Log booms are now being used extensively throughout the Pacific Northwest and New England to control floating debris, and research personnel believe that log booms could be used more extensively at other locations.

5. The character and amount of debris, the physical environment, and the environmental, legal, and economic considerations are dynamic and changing. Technology is also dynamic, since new equipment becomes available for disposal operations each year. All of these factors must be surveyed and evaluated periodically to maintain the most economically viable and operational disposal method at an impoundment.

4 FUTURE RESEARCH

In phase three of this work unit, researchers plan to investigate debris disposal problems associated with clearing operations conducted at impoundment locations.

During phase four, researchers will evaluate state environmental laws that may apply to debris disposal operations conducted at COE impoundments. The final report, prepared during this phase, will summarize all the previous research and emphasize the management concepts and implications of environmental laws concerning viable alternatives for debris disposal.

APPENDIX A:

LIST OF SUPPLIERS FOR CRUSHED FIREBRICK

This is a partial list of suppliers for crushed firebrick, which can be bonded by calcium-aluminate cement to create a concrete mixture capable of withstanding temperatures up to 2500°F (1371°C).

Butler Refractories Company, Box 751, Butler, PA 16001
Carolina Ceramics, Inc., Route 3, Columbia, SC 29609
Chicago Fire Brick Company, 1467 Elston Avenue, Chicago, IL 60622
Denver Fire Clay Company, 3033 Blake St., Denver 17, CO 80205
Dixie Fire Brick Company, Inc., 2301 Comer Building, Birmingham, AL 35203
General Refractories Company, 1520 Locust Street, Philadelphia 2, PA 19102
Gladding McBean & Company, Refractories Div., 2901 Los Feliz Blvd., Los Angeles 39, CA 90039 (Calcined Fire clays)
Davis Firebrick Co., Oakhill, OH 45656
A. P. Green Fire Brick Company, Mexico, MO 65265
A. P. Green Fire Brick Company, Sulphur Springs, TX 75482
Harbison-Walker Refractories Co., 307 Fifth Ave., Pittsburg 22, PA 15222
Illinois Clay Products Company, 208 S. La Salle St., Chicago, IL 60604
Massillon Refractories Company, Massillon, OH 44646
Mineral City Sand Co., P. O. Box 4, Mineral City, OH 44656
Mount Savage Refractories Co., 1201 Grant Bldg., Pittsburgh 19, PA 15219
H. K. Porter Company, Inc., Refractories Div., Porter Bldg., Pittsburgh 19, PA 15219
H. K. Porter Company, Inc., Refractories Div., 185 Canal St., Shelton, CT 06484
Richard C. Remmey Son Company, Div. of A. P. Green Fire Brick Co., Hedley St. and Delaware River, Philadelphia 37, PA 19137
Stevens Fire Brick Company, Div. of A. P. Green Fire Brick Co., Box 1284 Macon, GA 31207
Union Mining Co. of Allegheny Co., Inc., 2306 First Natl. Bank Bldg., Pittsburgh, PA 15222
Valentine Fire Brick Company, Div. of A. P. Green Fire Brick Co., Woodbridge, NJ 07095
Walsh Refractories Corporation, 101 Ferry Street, St. Louis 7, MO 63147
Western Materials Company, 39 La Salle Street, Chicago 3, IL 60603
Maryland Refractories Company, Alexandria, PA 16611
Inland Fire Brick Co., 3120 Berea Rd., Cleveland, OH 44111

APPENDIX B:

CORRESPONDENCE REGARDING BURNING AT DETROIT LAKE

MID WILLAMETTE VALLEY
AIR POLLUTION AUTHORITY
2585 STATE STREET / SALEM, OREGON 97301 / TELEPHONE AC 503 / 581-1715

February 21, 1975

Mr. Paul Peters
U.S. Government
U.S. Army Corps of Engineers
Foster, Oregon 97345

Subj: Open Burning Conducted at Detroit Reservoir

Gentlemen:

The staff of the Authority observed on February 15, 1975 debris being burned near the powerhouse entrance to Detroit Dam and has determined that this burning is in violation of the Authority's Open Burning Regulations.

The Authority's Board of Directors has adopted regulations that prohibit landclearing burning other than agricultural and slash burning exempted by State law. This revision was in accordance with Department of Environmental Quality regulations which prohibited landclearing in special control areas of the State after July 1, 1974.

Although slash burning is specifically exempted by statute, the debris being burned on the above date did not appear to have been generated from the direct harvesting of timber.

In order to comply with the Authority's revised burning regulation, all debris cleared from the reservoir would have to be burned in an Authority approved air curtain incinerator. Air curtain incineration means any device or method by which burning of waste is done in a subsurface pit or above ground enclosure with combustion air supplied under positive draft and controlled in such a manner as to optimize combustion efficiency and minimize the emission of air contaminants.

To ensure the Environmental Protection Agency that federal facilities are in compliance, please verify in writing to the Authority that you have reviewed the enclosed open burning regulations and guidelines and that your burning practices on the reservoir will comply.

MEMBER COUNTIES: BENTON / LINN / MARION / POLK / YAMHILL

Thank you for your cooperation in this matter.

Sincerely yours,

David St Louis

David St. Louis
Acting Director

DS/DK/ls/160

Encl.

cc: Environmental Protection Agency Region X
Norm Edmisten, Environmental Protection Agency
Operations Office

MID-WILLAMETTE VALLEY AIR POLLUTION AUTHORITY
2585 State Street - Salem, Oregon

CHAPTER III
STANDARDS AND PROHIBITED PRACTICES

Title 33

33-005 - OPEN BURNING RESTRICTIONS

(1) Except as provided in Section MWR 33-016, no person shall cause or permit any open outdoor fire or shall conduct a salvage operation by open burning except the following:

(a) Fires, on site, of wood, needle, or leaf material from trees, shrubs, or plants growing on real property used exclusively as a dwelling for not more than four families during the months of April, May, October, and November on burning days provided such persons or property so as to constitute a public or private nuisance, and subject to subsection 2 of this section, provided that after June 1, 1975, such burning shall be prohibited in the areas subject to the jurisdiction of the Mid-Willamette Valley Air Pollution Authority.

(b) Fires, including outdoor fireplaces and barbecues, used for cooking of food and small fires for ceremonial or recreational purposes.

(c) Agricultural burning under ORS Chapters 449, 476, and 478.

(d) Fires, set or permitted by any public officer, board, council, or commission for purposes of fire prevention, elimination of a fire hazard, or training for fire control.

(2) The open burning permitted by subsection (1) (a) of this section shall be subject to burning requirements and restrictions as follows:

(a) No burning shall be conducted except during the period of one hour after sunrise to one-half hour before sunset.

(b) Residential prunings and trimmings shall be sufficiently dried to prevent the emissions of excessive smoke.

(c) Allowed material shall be stacked or windrowed in piles and shall be free of surface moisture, dirt and green plant material.

(d) All allowed burning shall be constantly attended by a responsible person until extinguished and adequate equipment and tools shall be available to periodically re-stack the burning material to insure that combustion is essentially complete and to prevent smoldering fires.

(e) The Director may:

(1) Require auxiliary combustion equipment and materials, such as air curtain incineration, fans or diesel oil, propane and jellied diesel, to insure essentially complete combustion.

(2) Prohibit the burning of trees six inches in diameter or larger that is salvageable or merchantable.

(3) Require the extinguishing of smoldering fires where smoke escapes to property adjacent to the burning site.

(3) No open outdoor fire permitted under (1) (a) of this section shall be allowed on any day when the Director advises fire permit issuing agencies to not issue permits because such practices would have an adverse effect on air quality.

(4) Nothing in this section shall relieve a person responsible for such burning from the consequences of, or the damages, injuries, or claims resulting from such burning nor the requirement to obtain applicable fire permits from fire permit granting agencies.

33-010 - MATERIALS EXCLUDED FROM OPEN BURNING

(1) No open outdoor fire allowed by these Rules shall contain garbage, asphalt, waste petroleum products, paint, rubber products, plastic, wet leaves, green grass clippings, or any substance or material which normally emits dense smoke or obnoxious odors.

33-016 - AIR CURTAIN INCINERATORS

(1) "Air curtain incineration" means any method or device by which burning of waste is done in a subsurface pit or above ground enclosure with combustion air supplied under positive draft and controlled in such a manner as to optimize combustion efficiency and minimize the emission of contaminants.

(2) Air curtain incineration will be approved for the burning of landclearing debris or the cleanup of wood waste prohibited by this Rule provided that:

(a) No feasible or practical alternative to air curtain incineration exists.

(b) The installation or device is designed, installed and operated in such a manner that visible emission standards set forth in MWR 32-020 are not exceeded.

(3) An application for an Authority to Construct in accordance with MWR 21-010 shall be made and a notice of approval in accordance with MWR 21-020 must be granted before an air curtain incineration facility can be installed or operated.

NPOP-MWV

27 February 1975

Mr. Chan B. Bunke, District Forester
Oregon Department of Forestry
Route #4, Box 595
Molalla, OR 97038

Dear Mr. Bunke:

We are confused about the sequence of events that caused the Mid Willamette Valley Air Pollution Authority to send us a letter of noncompliance. A copy of the letter is inclosed.

The burning to which they refer was debris wood which washed into Big Cliff Lake. The material originated on the north side of Highway 22, and entered Big Cliff Lake by way of Sardine Creek as it leaves State Forestry land. The material is apparently residue accumulated from surrounding forest lands, and in some cases showed prior burn scars, probably the result of incomplete slash burning.

At any rate the burn in question was conducted under a burn permit from your office and on a burning day, so we thought we were in compliance. Any help you can give in this matter will be much appreciated.

Sincerely,

Incl: as

PAUL P. PETERS
Project Engineer

FORESTRY
DEPARTMENT
CLACKAMAS MARION DISTRICT
RT. 4, BOX 595 • MOLALLA, OREGON • 97038 • Phone 829-2216

March 14, 1975*

Mr. Michael Roach, Director
Mid Willamette Air Pollution Authority
2585 State St.
Salem, Oregon 97301

Dear Mike:

Attached is a copy of a letter I recently received from the Corps of Engineers and a copy of your Acting Director's letter to them concerning their burning of debris removed from Big Cliff Lake alongside Highway 22.

As Mr. Peters explains, this debris originated from Sardine Creek, an area that has been completely logged in the past. Much of the material removed from the lake did have cut ends which indicates residual logging debris. Hence, contrary to the statement in David St. Louis' letter, I do feel we were correct in issuing this permit.

I will also add, that the Portland office of the D.E.Q. (former Columbia Willamette Air Pollution Authority) has granted us approval to allow and regulate the burning of this type material that has washed down and collected in or alongside of rivers and streams. This approval includes governmental agencies, County Parks, etc.

In addition, we use our hazard reduction exemption to allow the burning of material that is removed from North Fork Lake on the Clackamas River. This material is mostly logging debris generated upstream and washed into the Lake during high water periods.

Assuming his position is correct, your Acting Director fails to mention the Corps' alternative of filing for a variance to your rules. I feel that everyone has this option open to them.

I would appreciate your early reply so I can respond to Mr. Peters.

Yours truly,

Chan Bunke, District Forester

CB:nf

cc: Paul P. Peters, Project Engineer, Corps of Engineers
Foster, Oregon 97345

*No response to this letter had been received by Mr. Bunke as of 27 June 1975.

CERL DISTRIBUTION

Chief of Engineers
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