Approved: 2-18-98
Date

MINUTES OF THE HOUSE COMMITTEE ON ENVIRONMENT.

The meeting was called to order by Vice-Chairperson Joann Freeborn at 3:30 p.m. on January 29, 1998 in Room 526-S of the Capitol.

All members were present except: Rep. Steve Lloyd - excused
Rep. Kent Glasscock - excused
Rep. Richard Alldritt - excused
Rep. Douglas Johnston - excused

Committee staff present: Raney Gilliland, Legislative Research Department
Hank Avila, Legislative Research Department
Mary Torrence, Revisor of Statutes
Mary Ann Graham, Committee Secretary

Conferees appearing before the committee: Randy Tongier, Audit Manager, Legislative Division of Post Audit, 800 SW Jackson, Ste 1200, Topeka, KS, 66612-2212

Edward A. Martinko, PhD, State Biologist & Director, University of KS, Kansas Biological Survey, Foley Hall, 2041 Constant Ave., Lawrence, KS, 66047-2906

Frank deNoyelles, PhD, Associate Director, University of KS, Kansas Biological Survey, Foley Hall, 2041 Constant Ave., Lawrence, KS, 66047-2906

David Penny, Mechanical Engineer, President, Master's Dredging Co. Inc., P.O. Box 554, Lawrence, KS, 66044

Others attending: See attached list

Chairperson Joann Freeborn called the meeting to order at 3:30 p.m. She announced a change in the sub-committee on Confined Animal Feeding Operations that was appointed in the January 28 committee meeting. Rep. Kent Glasscock, Chairman; Rep. Sharon Schwartz, Rep. Tom Sloan, Rep. Laura McClure and Rep. Vaughn Flora, who will replace Rep. Dennis McKinney. Rep. Glasscock has scheduled a meeting on Friday, January 30, 1998, on adjournment of the House, to organize the sub-committee. On today's agenda no action will be taken on **HB2419**, the sub-committee is not ready to submit their report. Also Monday, February 2 will be the last day for bill requests.

The Chairperson asked if there were any bill requests by committee members, agencies or individual citizens.

Rep. Laura McClure requested a Resolution that would standardize the 305 B reports. Seconded by Rep. Marti Crow. Motion carried.

Chairperson Freeborn welcomed Randy Tongier, Audit Manager, Legislative Division of Post Audit. He appeared to review the Compliance and Control Audit of the Department of Wildlife and Parks. (See attachment 1) Compliance and control audits are audits of a state agency's financial management practices that are focused into certain areas at the direction of the Legislative Post Audit committee. They are called for by the Legislative Post Audit act and done by Legislative Post audit staff. This audit looked at whether the Dept. of Wildlife and Parks adhered to state and federal spending restrictions on its funds, and whether the Department made sure that local agencies adhered to spending restrictions on moneys those local agencies got from the Department. In general, the Department was found to have adhered to its own spending restrictions, and made sure that local agencies adhered to their spending restrictions. This is a routine audit which is done every three years.

MINUTES OF THE HOUSE COMMITTEE ON ENVIRONMENT, Room 526-S Statehouse, at 3:30 p.m. on January 29, 1998.

The Chairperson congratulated Secretary Williams on the changes he has brought about in the Department of Wildlife and Parks and atated that this is a good outcome from the audit. She feels he is to be congratulated for his leadership. She asked if there were any questions and thanked Mr. Tongier for coming.

Chairperson Freeborn announced that she has received information from Iowa State University concerning the Thu study quotes made by Mr. Craig Volland, President, Spectrum Technologists, in his presentation on January 26, 1998. This was in regard the air quality of Confined Animal Feeding Operations and the affect on health. She contacted Dr. James Zahn of Iowa State University. He said there is not enough current data to uphold the Thu studies. Rep. Freeborn has a copy of that study and a letter from Dr. Thu. Dr. Zahn will make comments concerning this issue in his presentation next week, February 4, 1998.

The Chairperson welcomed Dr. Edward Martinko, State Biologist and Director, KS Biological Survey. Dr. Martinko gave a summary on "Siltation and Water Quality Issues in KS Reservoirs, Causes, Consequences, and Remedial Actions". (See attachment 2) He reviewed satellite maps showing KS Land Cover Patterns and of KS Gap Vegetation. From its original charge to study the plants and animals of the State, KBS has developed a national reputation in statewide and regional research including field monitoring, applied remote sensing, geographic information systems, natural heritage and biological diversity, prairie and wetland restoration, and water quality.

Dr. Martinko introduced Jerry deNoyelles, Ph.D., Associate Director, KS Biological Survey, to the committee. Dr. deNoyelles briefed the committee on Siltation in KS Reservoirs, a natural process to be managed, the Consequences of Reservoir Siltation and Remedies for Reservoir Siltation. (See Attachment 2) He also discussed recommendations for continuing the consideration of siltation and water quality issues in Kansas reservoirs over the next several years. Dr. deNoyelles had a sample of water, which he had committee members smell, with Geosin, which is associated with taste and odor problems in drinking water.

Dr. deNoyelles introduced David Penny, Mechanical Engineer, President, Master's Dredging Company. Mr. Penny briefed the committee on dredging techniques and costs. (See attachment 3) In the near future a number of large reservoirs in Kansas may be turned over to the State of Kansas by the federal government. Most of these reservoirs were built in the late 1950's through the 1970's with life expectancies of 100 to 120 years. Several are filling in much faster and may have expectancies of 60 to 70 years. Dr. deNoyelles suggested the state needs to have a long term maintenance dredging program to address this problem for flood control. Questions followed.

Rep. Tom Sloan asked Dr. deNoyelles for an outline of the coordination among state agencies and other cooperators as to what should be done to address this issue as a guide for legislators.

Chairperson Freeborn thanked guests for their presentation.

Rep. Dan Johnson announced sub-committee on **HB 2419** will meet Monday, February 2, at 7:30 a.m. in the East Lounge.

The meeting adjourned at 5:10 p.m.

The next meeting is scheduled for Monday, February 2, 1998

HOUSE ENVIRONMENT COMMITTEE COMMITTEE
GUEST LIST

DATE: 1-29-98

NAME	REPRESENTING
David Perry	The Master's Dredging Co.
Jerry deNoyelles	Kansas Biological Survey
Ed Martinko	Kansas Biological Survey
Randy Tongier	Legislative Post Audit
Blythe Ridenour	Intern - Rep. Johnson
Larry Kleeman	League of KS Municipalities
[illegible]	Intern (Schwartz)
David Pluiath	Farmer
Lee Smith	
Susie Hoffman	SWKROA
Don Snethen	KDHE
Tom Stiles	KWO
Wendy Harms	KAPA
[illegible] Hein	Hein and Weir
Todd Thompson	Intern for Rep Sloan
Cathy Tucker-Vogel	KS Water Office
Tracy Streeter	Conservation Commission
Steve Williams	KDWP
Dick Koerth	KDWP

HOUSE ENVIRONMENT COMMITTEE COMMITTEE
GUEST LIST

DATE: 1-29-98

NAME	REPRESENTING
Charles Benjamin	KNRC/KS Sierra Club

Compliance and Control Audit of the
DEPARTMENT OF WILDLIFE AND PARKS

Presentation to the House Environment Committee
January 29, 1998

Randy Tongier, Audit Manager
Legislative Division of Post Audit

Compliance and control audits are audits of a State agency's financial management practices that are focused into certain areas at the direction of the Legislative Post Audit Committee. They are called for by the Legislative Post Audit Act, and are done by Legislative Post Audit staff.

This audit looked at whether the Department of Wildlife and Parks adhered to State and federal spending restrictions on its funds, and whether the Department made sure that local agencies adhered to spending restrictions on moneys those local agencies got from the Department. Our testwork didn't look at all the Department's programs, but rather focused on a sample of those programs.

In general, we found that the Department adhered to its own spending restrictions, and made sure that local agencies adhered to their spending restrictions. The audit resulted in the following two findings:

- The Department's adherence to spending restrictions had been a problem area at one time. In fact, several years ago State and federal audits found that the Department didn't adhere to federal spending restrictions on wildlife moneys. As a result, State General Fund moneys had to be used to restore wildlife moneys spent in violation of those restrictions.

  Since that time, the Department has invested considerable time and effort toward correcting that situation, and has made significant improvements in its systems and procedures. Our current audit work found that those improvements have been effective. We saw no evidence of spending restriction violations like those found in the past. Further, we concluded that the Department's current systems and procedures should be effective in preventing future such violations.

- For the programs we looked at, the Department's procedures for ensuring that local agencies adhere to their spending restrictions include such things as prior approvals of local projects to be funded by the Department, inspections of local projects before payment of funds, and periodic reviews of local projects. Those kinds of activities provide good oversight of local spending.

  In addition, where federal moneys are involved, the local agencies must comply with federal audit requirements. We found one program where the Department's grant manager wasn't aware of all the federal audit requirements, and hadn't established procedures to make sure that local agencies met those requirements. We saw no evidence of improper local spending, but did recommend that the Department establish procedures to make sure it obtains and reviews the federally-required audit reports. In its written response to that recommendation, the Department agreed to implement that recommendation.

HOUSE ENVIRONMENT
1-29-98
Attachment 1

SILTATION AND WATER QUALITY ISSUES IN KANSAS RESERVOIRS: CAUSES, CONSEQUENCES, AND REMEDIAL ACTIONS

Summary of a Presentation Provided by the Kansas Biological Survey,

Edward Martinko
State Biologist and Director
Kansas Biological Survey and
Kansas Applied Remote Sensing Program
Lawrence, Kansas

Jerry deNoyelles
Associate Director
Kansas Biological Survey
Lawrence, Kansas

and by an Independent Dredging Specialist,

David Penny
Mechanical Engineer
Lawrence, Kansas

The Kansas Biological Survey: monitoring Kansas natural resources

Balancing society's needs with the wise use of natural resources is fundamental to future economic growth in the State of Kansas. The Kansas Biological Survey (KBS), which includes the Kansas Applied Remote Sensing (KARS) Program, is making crucial contributions to the development of strategies for sustainable resource utilization. For more than a century, KBS has been an indispensable source of biological and ecological information about Kansas and the Great Plains. As a non-regulatory research and service agency of the State of Kansas located at the University of Kansas, its roots go back to 1865 and the founding of the University. From its original charge to study the plants and animals of the State, KBS has developed a national reputation in statewide and regional research including field monitoring, applied remote sensing, geographic information systems (GIS), natural heritage and biological diversity, prairie and wetland restoration, and water quality.

Siltation in Kansas Reservoirs: a natural process to be managed

European settlers when they first came to Kansas in the 1800's saw the great wealth of natural resources supported by the deep rich soils of the Great Plains. Native Americans had long depended on these resources for their way of life which included agriculture. Underlying these Kansas soils is a geology of mostly sedimentary rock. This rock in its various forms (e.g., shale, gypsum, limestone, sandstone) is formed by the weathering process and by certain other chemical and biological processes all producing fine particles later

House Environment
1-29-98
Attachment 2

deposited on the bottoms of oceans and lakes, along streams and rivers, and even over the land from flooding and wind action. These particulate materials as they are first deposited form the soils. As great depths accumulate over thousands, even millions, of years, the deepest layers solidify into sedimentary rock.

These are all natural processes that continue today and in Kansas continue to provide much of the landscape with a covering of deep deposits of fine particulate material, our soils. These soils are readily moved about by water and wind and now also by various human activities. Kansas has 12 major river basins with 134,338 miles of streams (Figure 1). Along these streams we have constructed 279 public reservoirs with a total surface area of 173,801 acres (1994 Kansas Water Quality Report). Even more acres of privately owned reservoirs and farm ponds have been constructed.

Our reservoir (Figure 2) and pond basins, most constructed from the 1920's to the 1980's, are located along stream courses and are thus forced to act as settling basins receiving particulate materials (Figure 3), commonly termed silt. These basins are rarely formed naturally in Kansas. They had to be constructed where they previously did not exist and have become another resource in our State, a resource providing flood control, water for human and livestock consumption and for irrigation, and recreation of many types. These basins are filling at varying rates with silt by the natural siltation process, but a process that humans can greatly influence by either increasing or decreasing the rate.

As our reservoir and pond basins fill, all of their uses are steadily diminished even long before a large percent of their original volume has been lost. We recognize that considerable time and expense was required to place these more than 300,000 acres of surface water basins across the Kansas landscape. Now we must also recognize that time and expense will be required to maintain these resources. As will be discussed below, we cannot simply allow them to fill and then build new ones elsewhere or at the same location. Elsewhere is not practical since all of the best locations were originally used and at the same location would be prohibitively expensive.

The consequences of reservoir siltation: the declining resource

The fine particulate materials of the siltation process enter reservoirs primarily from the streams (Figure 3) and much is deposited in the upper arms of the reservoir (Figures 2-4) where the streams enter. Materials readily settle out of the waters just after first entering the reservoir, since these waters now begin to move more slowly through the upper arms. The waters in the upper arms, generally narrow protected areas of the reservoir, are also less stirred-up by winds than elsewhere in the basin. These areas (Figure 4), though far from the dam and main standing volume of the reservoir (Figure 4), have a great influence on the entire system, as we are still discovering, and are the areas of the reservoir most directly impacted by the siltation process (Figure 3,4). Most of the water maintaining the reservoir first resides in these upper arms with time enough for conditions there to exert their influence, thus ultimately on the entire reservoir.

We are approaching the end of the 20th century and recognize that we have been using the existing reservoirs as a resource for 20 to 80 years. Enough time has passed to allow us to recognize an aging process as changes in the condition, including quality, of these resources. Though we are still searching for exact causes, siltation is the most obvious stress on the system. We clearly recognize a number of changes that are caused by siltation and have problems associated with them. These problems can be placed in two broad categories, one being declines in water quality involving unacceptable materials in the water. The other involves declines in habitat quality with unacceptable changes in the structure or appearance of the reservoir habitat.

Today, considering all types of reservoirs and their multiple uses, the problem most often reported by the public is the occurrence of unacceptable taste and odor conditions in water from municipal supply reservoirs. Of the 279 public reservoirs in Kansas 90 are used for drinking water supplies with about 80% of the total acres of public reservoirs serving this use (personal communication Bureau of Environmental Field Services, Kansas Department of Health and Environment). Of the 24 large federal reservoirs (greater than 1000 acres) 20 are used for drinking water supplies. About one third of the population of Kansas receives some of its drinking water from reservoirs. In our presentation as summarized by this document, we focus on addressing this particular problem of taste and odor and will only summarize others along with their relationship to siltation.

In May of 1997 the most extensive water quality study in recent years of a Kansas reservoir was begun by the Kansas Biological Survey (KBS) on Clinton Reservoir in Douglas County. This study was initiated in response to an increasing frequency of public complaints concerning drinking water taste and odor. One such episode in October and November of 1995 led to the shutdown of the City's Clinton Reservoir Water Treatment Plant for eight weeks during December and January and water from the Kansas River was used instead. Complaints from the public were again received in the fall of 1996 and 1997 but conditions were not severe enough to shut down the plant. With the rapid growth in population in the vicinity of this reservoir, it now provides drinking water for more than 100,000 customers, the largest customer base of any reservoir in Kansas. This 7000 acre reservoir was constructed about 20 years ago by the US Army Corps of Engineers.

Taste and odor problems have been reported from water supply reservoirs throughout the Great Plains for decades but only since the 1970's have we been able to relate this to a particular chemical, geosmin, isolated from the water. It has only been in the past few years that analytical procedures have become acceptably accurate and inexpensive to support more routine monitoring for the presence of geosmin in drinking water supplies. Geosmin is an alcohol compound produced in the reservoir water by certain natural biological processes and can be detected as an odor by humans at a concentration as small as 5 nanograms/Liter (5 parts per trillion or 5 trillionths of a gram). This is a concentration considerably below the levels that toxic chemicals sometimes found in water supplies exert their influence. Geosmin is not known to be toxic to humans or wildlife at even the highest concentrations detected in reservoirs. However, when geosmin is present in the water drawn from a reservoir, it is very difficult and costly to remove at the treatment plant such that taste and odor problems are not passed on to the consumer.

Is the production of geosmin in reservoir water affected by the natural progressive siltation of reservoirs or by the accelerated siltation sometimes caused by human activities? This is one question now being addressed by KBS's Clinton Reservoir study (Figures 2,4) begun in May 1997. At the start of this study still little was known about the production of geosmin as related to particular reservoir conditions. Some eight months later we are beginning to identify cause and effect relationships associated with particular environmental conditions found in Clinton Reservoir. Currently, for other reservoirs in Kansas we know less about particular environmental conditions, including geosmin levels. What follows is a discussion of relationships we are learning about in Clinton Reservoir, but with some examination of other reservoirs, similar relationships may be found everywhere in the future.

Though the Clinton Reservoir study is not complete, there is growing evidence that the production of geosmin in a reservoir, at least in Clinton Reservoir, is related to siltation. Geosmin is a chemical produced in a reservoir mostly by certain microorganisms, including some types of bacteria, fungi, and algae. Geosmin is produced during the growth of these organisms. The bacteria and fungi grow by decomposing organic matter suspended in the water and on or in the bottom sediments. The algae grow as plants suspended in the water or on surfaces utilizing energy from the sun and nutrients from their surroundings. Some geosmin is released from the living organisms but most, about 90%, seems to appear dissolved in the water immediately upon the death and breaking apart of these organisms. The relationship to the siltation process becomes evident when certain conditions in the reservoir (Figures 3,4) greatly affected by siltation are also observed to accelerate the growth and ultimately also the death of these microorganisms.

Certain conditions in the reservoir can be considered as either being caused by siltation or accompanying siltation (but not caused by it). These conditions (Figures 3,4) include the following: expansion of shallow water zones overlaying silt deposits; periodically exposed silt deposits; high nutrient levels in shallow waters; more total volume of reservoir water occupying increasingly shallower areas; and elevated nutrient levels throughout the entire reservoir. It will be noted later in this summary that these same conditions are related to most of the other problems that we experience in reservoirs as they age. With respect to geosmin taste and odor problems all of these conditions are expected to stimulate the growth of microorganisms in a reservoir and in our current study we are seeking verification of this.

Expanding shallow zones provide more surface for these microorganisms to grow on which for the bacteria and fungi means more well aerated surface containing more organic matter to decompose for energy and nutrients. For the algae there is more surface with ample light and also more surrounding nutrients released by the decomposition processes provided by bacteria and fungi. The growth of this entire community of microorganisms is even further stimulated by periodic exposure to the air which creates new conditions that allow the appearance and growth of more groups of microorganisms. Deeper water columns in reservoirs tend to reduce the growth of microorganisms, particularly the suspended algae, which circulate to deeper zones of insufficient light. Algae growing on bottom surfaces are unable to grow in deep water because of sufficient light. With average water depths declining throughout the entire basin, though more dramatically in the upper arms where most of the silt is deposited (Figures 2,4), microbial growth increases everywhere. Finally, the fine particulate material eroded from the land and entering the reservoir also brings more nutrients to all of these microorganisms or is invariably accompanied by more nutrients. By recognizing these effects of siltation, on taste and odor and on other problems, we can begin to develop remediation measures as identified in the next section of this summary document.

Other reported problems that we experience in reservoirs as they age are also increasingly understood to be related to siltation. The KBS study of Clinton Reservoir is also gathering more evidence of this as well. It is not difficult to recognize that other uses of reservoirs such as for irrigation and flood control are diminished as their volumes or water holding capacities decline as the basins become smaller with continued silt deposition. This is seen more dramatically in the oldest reservoirs, in the smaller ones, and in those whose watersheds are particularly vulnerable to soil erosion. Deteriorating water quality conditions can also impact the reservoir as a resource for irrigation water or water for domestic animals. Smaller reservoirs and farm ponds in particular can develop such prolific growths of microorganisms that the water becomes impalatable, even toxic, to livestock and also inhibitory to the growth of crops, because of the biomass of these organisms or the chemical conditions that they create in the water.

In reservoirs used for recreation, the impact of siltation can be easily recognized with a few examples. With respect to fishing, bays that some fish prefer are filled and bottom habitats that attract fish and support their reproduction are covered. Large accumulations of algae and rooted flowering plants inhibit good growth of fish populations and also make them harder to catch, while boating to desirable fish habitat also becomes obstructed. The "aesthetics" of the reservoir environment are also impacted by siltation (Figures 3,4) when one considers the various expectations of the public, which include the ability of the area to support a diversity of wildlife. In the more advanced stages of siltation, often observed now in smaller reservoirs of less than 500 acres, there is a loss of diversity of habitat and thus diversity of wildlife. Swimming coves and beaches become covered with rotting plant material and picnic areas no longer provide the views of nature most sought by the public.

For this presentation we have considered reservoirs to be an important resource in Kansas and have sought to better explain the effects of siltation. We do recognize the impacts of other potential disturbances like inflows of domestic, industrial, and agricultural contaminants. Even certain well-established reservoir management practices can be unintentionally disruptive. We do not intend to portray all of the problems encountered in reservoirs as being caused by or even related to siltation, but we do contend that siltation is the <u>single</u> most disruptive condition. It is important to again recognize, particularly when remedies are sought, that siltation is contributed by both natural processes and by human activities.

Remedies for reservoir siltation: longer-term controls and more immediate fixes

In the final section of this summary document we now turn to remedial actions. Here we will be brief since our work on Clinton Reservoir is in progress and not yet to the final stage for another eight months. For now we will identify the more practical and economical longer-term measures and then measures that are emergency "quick-fixes", more often neither practical nor economical. It will urely be necessary someday to resort to the quick-fix if other easures now in place are not continued and new ones are not soon nacted. "Someday" for our reservoirs is now for some of the smallest d oldest and at best 50 years for most of the others.

The siltation of reservoirs is best controlled over the longer rm by controlling the amounts of fine particulate materials from rface water runoff entering with streams. For many years in Kansas ctices to control soil erosion have been developed and implemented. our grandparents only 50 years ago not done this, particularly r the Dust Bowl period, many of our smaller reservoirs would be today. These measures must be continued and further advanced to ven more effective. However, as discussed at the beginning of summary document, even the best management practices on land t eliminate the siltation of our reservoirs for this is also a al process in our region of North America. Even with the best management practices that we are now able to identify and could ment, the life expectancy of most reservoirs in the State is stically 100 to 200 years. Most likely the majority of our and large reservoirs will be so impacted by siltation within 50 that they will no longer provide most of their originally ed multipurpose uses.

quick-fix" measure is most often some type of direct silt . This can be excavation with earth moving equipment if of the reservoir can be drained and sufficiently dried to the equipment (Figure 5). Dredging, using floating equipment, been used following methods more commonly developed in rivers sand (Figure 5). Today, with increasing need to reclaim some st impacted reservoirs throughout the US, new dredging re being developed and implemented. Some of the most promising development is being done in Kansas, but as yet no implementation in our reservoirs has occurred. Dredging even a small reservoir is very expensive once it is recognized that about 100,000 cubic yards of silt would need to be removed to reclaim the resource. The cost per cubic yard with more traditional methods, those not employing new innovations, can be $8 to $15 per cubic yard. More than $1,000,000 would likely be incurred for even the smallest water supply reservoir. The large federal reservoirs would require the removal of more than one million cubic yards at a cost of more than ten times that identified above. New methods being developed in Kansas could lower this cost to $3 per cubic yard. Some of these new methods will be discussed during the presentation. These new methods also address the great disturbance of the reservoir that can occur during the process of dredging that some older methods cannot avoid. There are many small and a few large reservoirs in the state today that should receive some direct silt removal to reclaim all of their multipurpose uses.

As we develop better long-term management practices to address reservoir siltation, limited dredging may need to be included, particularly in the upper arms of reservoirs where most of the silt accumulation first occurs. Temporary draining of these areas followed by excavation as an alternative to dredging is often limited by the opportunity to partially drain the basin. There is also the limitation that even if drained, the area does not become dry enough to support excavation equipment for a long enough time to complete the task. We suggest at this point that periodic dredging, perhaps every 10 to 20 years, in the arms of many small and large reservoirs will be necessary to extend their value as a resource beyond the next 50 years. We also suggest that this should include restructuring of the upper arms to create deeper areas, deeper than at the time of original construction. These will function as settling basins that will further protect the main basin and greatest volume of water from some of the impacts of shallow areas as discussed earlier. Dredging done selectively and skillfully should become part of longer-term management programs, particularly when one considers that "eventually" all reservoirs will fill with silt to an extent that they will no longer be the resource that was once intended.

Recommendations for continuing the consideration of siltation and water quality issues in Kansas reservoirs over the next several years

1- Over the next three years at least two more of our largest reservoirs, those over 1000 acres, should be studied in the same detailed manner that Clinton Reservoir is now being studied.

2- At the same time currently available information on all of the other large reservoirs should be assembled as well as some new data gathered.

These studies of large reservoirs will provide an extensive database from which to develop management strategies for addressing siltation problems and for addressing other problems as well for the next several decades.

3- For a second three year period at least four of our small reservoirs, those less than 1000 acres, should be studied in the same detailed manner that at least three of the larger ones were studied during the preceding three years.

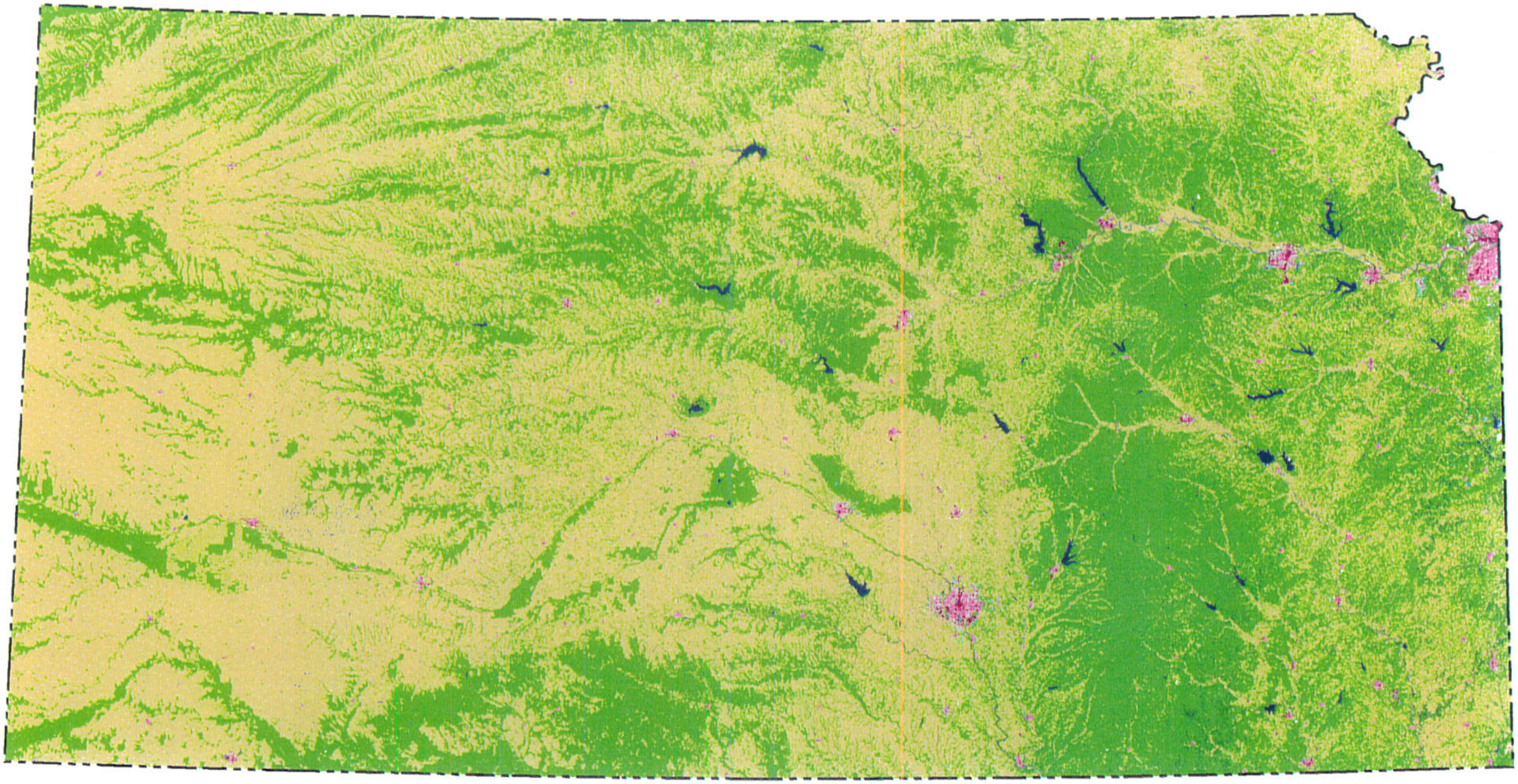
4- At the same time currently available information on at least fifty small reservoirs should be assembled as well as some new data gathered.

These studies of small reservoirs along with the studies of large ones will provide detailed comparisons of all for developing the most effective and inexpensive management practices to maintain these resources for the decades to come.

5- As soon as sufficient private and government funds can be secured, a pilot dredging project should be initiated on an entire small reservoir or on the upper arm of a larger reservoir. We must put into practice new methods now being developed in Kansas in order that further method development can proceed. Sooner or later some of our reservoirs will require selective dredging to maintain them as a State resource.

2-9

Kansas Land Cover Patterns

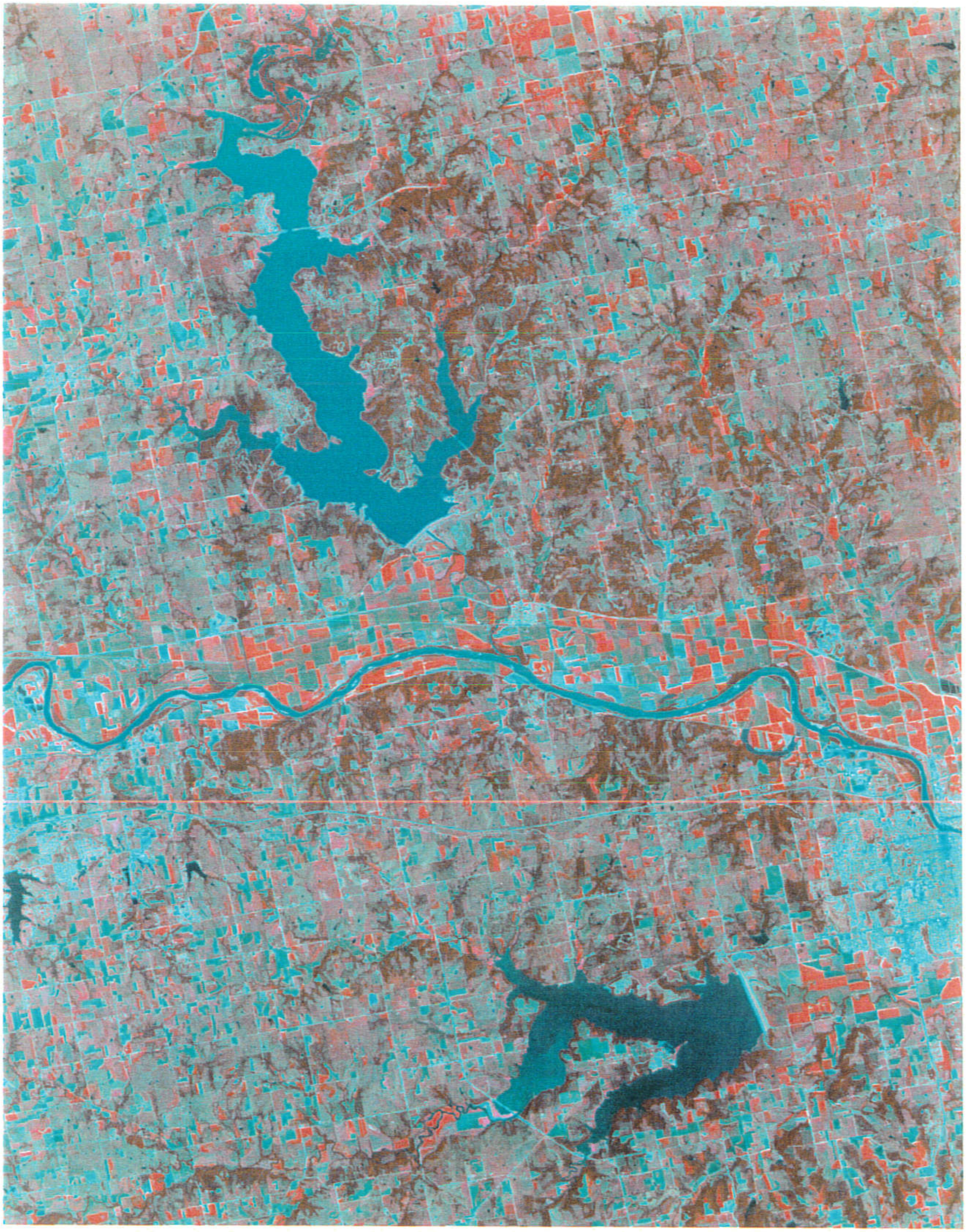


Residential
Commercial
Urban Openland
Cropland
Grassland
Woodland
Water
Other

KARS
Kansas Applied Remote Sensing

KANSAS BIOLOGICAL SURVEY

Perry and Clinton Reservoirs, September 1982



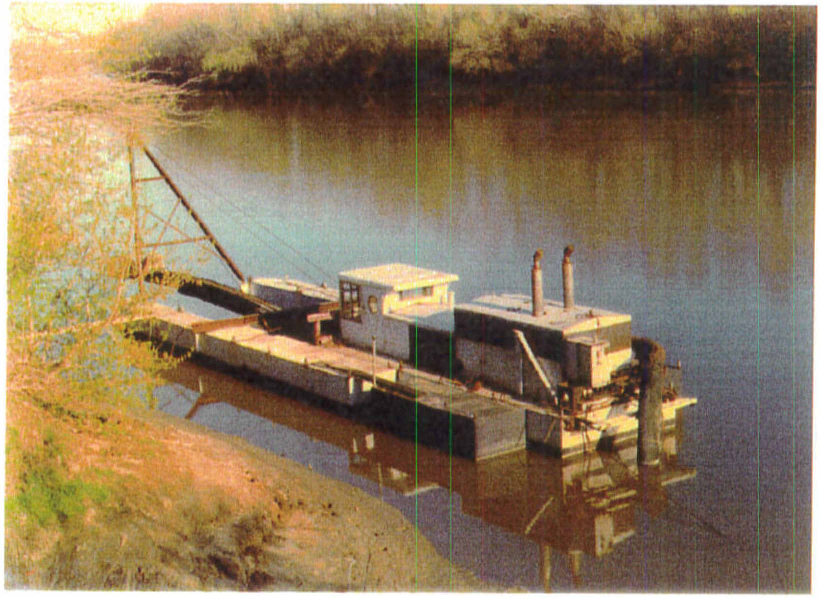
KARS
Kansas Applied Remote Sensing

Scale 1:203,000
1 inch equals approximately 3.2 miles

Miles
2 0

KANSAS BIOLOGICAL SURVEY

Figure 2. Perry (upper) and Clinton (lower) reservoirs, Landsat Thematic Mapper false color composite, September 1982.



Floating dredge unit.

Small basin with siltation and dredging from the shore.

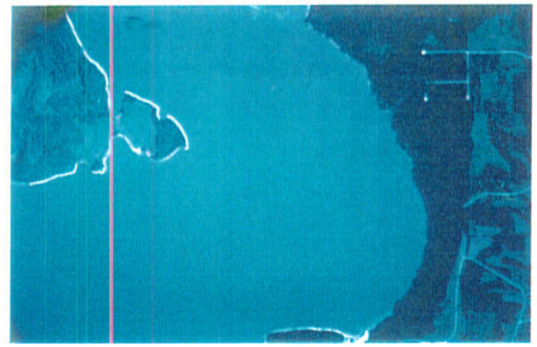
Small basin with siltation and dredging from floating unit.

Dredged silt being deposited on land behind holding dikes.

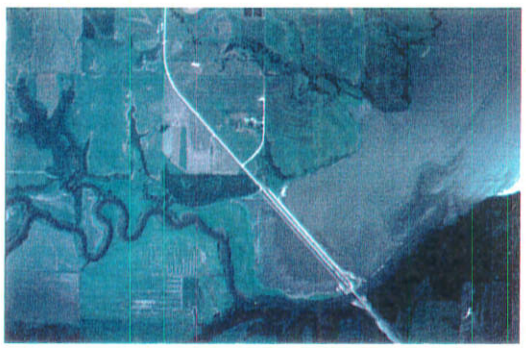
Figure 5.

2-11

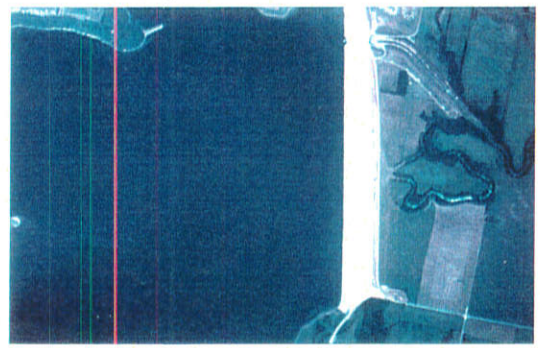
Upper arm of Perry Reservoir.



Main basin of Perry Reservoir.



Upper arm of Clinton Reservoir.



Main basin of Clinton Reservoir.

Figure 4.

Fine soil particles.

Siltation in stream entering reservoir.

Siltation in upper arm of reservoir.

Shallow arm with early stages of plant growth.

Shallow arm with extensive plant growth.

Shallow area with extensive plant growth.

Figure 3.

DREDGING KANSAS RESERVOIRS
BY DAVID PENNY

INTRODUCTION

In the near future a number of the large reservoirs in Kansas may be turned over to the State of Kansas by the federal government. Most of these reservoirs were built in the 1950's through the 1970's with life expectancies of 100 to 120 years. Their purpose is to moderate the flood-dry cycles. Unfortunately several are filling in much faster and may have expectancies of 60 to 70 years. Others such as Perry Lake have their tributary arms full. This has created water quality problems for cities such as Ozakie and rural water districts which draw their water from the lakes. In any case, all the lakes with both short and long lives need continual maintenance to remove sediment at the same rate that it is being deposited into the reservoirs. Most lakes precipitate nearly 100% of the sediment that their tributary rivers and creeks carry. They eventually will fill up and loose their water storage and flood control capacities along with their wildlife and recreational uses. Almost no thought was given to this problem when the reservoirs were built. No plan of action has been implemented to maintain the storage capacities of the dams at a constant level.

A neglect of this maintenance will lead to monumental financial, economic, and ecological prices to be paid in the not-too-distant future. A remedy for dam replacement or reconstruction will be economically and environmentally prohibitive. Most of the dams are built on the best or only sites for water impoundment on the respective rivers. This excludes the building of new dams at other sites with the additional loss on farm land. Increasing the storage capacities by raising the dam elevations increase earth works and construction costs enormously. This also floods most of the infrastructure surrounding the lake and requires the acquisition of large acreage in the back of the reservoir. Draining a reservoir and removing the sediment with earthmoving machines is difficult and expensive. Ten to twenty times the volume of the material moved in the original dam construction must be removed under very difficult, wet conditions. The reservoir must be refilled and aquatic life reestablished. The whole cycle is long and cost prohibitive.

In the light of the above, maintenance dredging is usually the method of choice to prevent the inevitable death of the reservoir. To avoid the crisis of this, regular maintenance and the acquisition of a location for long term placement of sediment needs to be in place years before the crisis. Also the funding mechanism to pay for the maintenance of the reservoir at a constant capacity needs to be in place. The chief beneficiaries of the reservoir and those most affected by the potential loss of the reservoirs should probably be funding this maintenance.

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Attachment 3

SEDIMENT AND DISPOSAL SITE

The nature of the sediment and a home for it must be preliminary considerations. Samples need to be taken to determine if there is the presence of any harmful chemicals or elements. In rural Kansas reservoirs there may be agriculture fertilizers and chemicals that are entrapped in the sediment. However, the levels are probably low. Most reservoir sediments, even urban ones with lawn and pesticide chemicals, have nearly no chemical residues. But tests must be run to confirm this.

Secondly, the depth and density of the sediment is important in order to determine the volume to be removed and the type of dredge to do the job. The depth can be determined by probes or under water topographical surveys compared to original cuts. The probes give a more accurate estimate as original plans are not available or are inaccurate. Also is the material to be dredged 100% silt or is there virgin soil or rock to be dredged?

Thirdly, a location to dispose of the sediment needs to be found. Preferably this site should be (1) near the tributary arms where the sediment exists, (2) large enough to handle sediment, far into the future, (3) not at an elevation much above the lake level, (4) upstream from the lake. The cost of dredging is minimized by keeping the pump line as short as possible and the discharge point as low as possible. Increasing the distance or lifting the head can significantly change the dredging costs. Keeping the site upstream allows the return water to come back to the lake by gravity, rather than pumps in the case of a site below the dam. In the case of larger reservoirs, it may not be necessary to return the water to the lake. The disposal site needs to be rather large to allow for silt removal in the distant future. In every case the disposal are should be as near to the sediment as possible and as large as possible.

TYPES AND SIZES OF DREDGES

Two types of dredges are usually used for reservoir maintenance. The most common is the cutter suction dredge. It has a rotary cutterhead and is generally moved from side to side in an arc and advances between swings. The other kind is a dustpan with a mechanical cutter or high pressure jets. It advances in a cut a little less than the width of the dustpan. It then backs up to make the next parallel cut. The dustpan is most efficient in shallow deposits with large dredges and leaves a flatter bottom. The U.S. Corps of Engineers uses these extensively on large rivers. The cutter suction is usually used in deeper cuts and virgin cuts where the material is harder.

The size of dredge is determined by the diameter of the discharge line. For example, and 8" dredge has a 8" discharge line. There is definitely an economy of size in dredges. The larger pipeline uses less energy to pump sediment a given distance. Also the larger pumps can pass larger diameter stones, tree branches, etc. found in the silt, which reduces shut-down time. The cost of the equipment does not increase in the same portion as the increase in pumping capacity. Doubling the pumping capacity does not double the cost of the dredge. However, it is not cost-effective to spend a month setting up a large dredge to do only a day's work. In the is case, a small dredge would obviously be better.

The following chart gives some idea of dredge size, output, capacities and line losses:

DREDGE SIZE Inches (Diameter)	OUTPUT CAPACITY GPM (at 17 fps velocity)	LINE LOSSES Feet of Head loss per 100' of line
8	2,700	14
12	5,900	8
20	15,270	4.75
24	21,200	3.75

A rough rule of thumb is to use 8-10" dredges on jobs of 100,000 cubic yards or less; 12"-18" on 100,000 to 1,000,000 cubic yards; and 20"-24" on 500,000 cubic yards and up. Since dredge pumps generally develop 200-250 feet of Head (80-100 psi), the pump lines are limited in distance on pumping across flat land to 1500' for 8" dredges, 3000' for 12" dredges, and 8,000' for 24" dredges. Additional horsepower and special pumps increase the dredge's pumping pressures and distance. Also, additional pumping distance or the height can be obtained by booster pumps.

Several variables affect the actual dredge production. The density of sediment (most in Kansas have a specific gravity of 2.6 in sand and clay soils) and it's compaction <u>in situ</u> change the cutting power and the pump horsepower requirements. The depth and suction design characteristics of the dredge can dramatically change the percentage of solids in the line. For example, changing the percentage of sediment from 10% to 30% as a running average increases production over 300%! The ability and attentiveness of the operator to maintain the percentages even with a well designed dredge can make production differences greater than that. A poorly designed dredge or a poor operator rarely maintains a 10% average. In contrast, a dredge with jets or underwater pumps and a good operator can easily average 30% or more of solids. Although the hourly costs do not greatly change whether the dredge pumps 0% or 30% solids, the cost of sediment pumped changes dramatically.

In consideration to the type and size of dredge, it is most cost effective to use the largest and most powerful dredge possible. If the sediment is shallow, a dustpan is preferable to a cutterhead. If the disposal area is beyond the dredge's pumping distance, booster pumps can be added. Dredge size, power, suction design, and operator skills are prime considerations for cost effectiveness.

OTHER DESIGN VARIABLES

Engineering design can play a role in costs. First of all, if there is a choice of areas to be dredged, several options should be strongly considered. Many reservoirs have standing trees submerged in the tributary arms. These were left for fish and bird habitat. However, dredging in such areas are inefficient and costly. Trying to save the trees makes dredging in between them difficult and slow. On the other hand, removing the trees involves undercutting them into virgin ground or rocks. This is also costly and time consuming. Such areas are best not included in the dredging plan. Also thinner layers of sediment are more expensive per cubic yard than thick layers to dredge. The thicker deposits of sediment should be maximized in the dredging plan if at all possible.

Secondly, if there is a choice of areas to dispose of the sediment, consideration should be given to flat areas near to the sediment removal area. The disposal area would need to be bermed to contain the dredged silt. The flatter the land the better. Sloped land requires more earthworks to contain the silt. Future depositation at the site could be made by berms built on the previously pumped silt but stepped back from the previous berms. Silted-in parts of the lake should be considered as disposal sites. Causeways and berms would need to be constructed to contain the dredged material. In addition, a waterway for the tributary to flow into the lake must always be maintained and designed for maximum flow conditions. These disposal areas in the lake itself could be plateaued and pyramided by berms for future dredged sediment. Flat land near the area to be dredged or silted-in areas in the lake provide some of the best disposal areas.

COSTS AND PRODUCTION OPTIONS

Several components of cost affect the total cost of dredging a reservoir. The dredging itself breaks into several parts. The dredge cost will include mobilization/demobilization costs and running costs. The running cost will vary with the depth of the sediment layer, size of dredge, type of dredge, and size of job. Secondly, the distance and elevation to the disposal area will affect the length and type of pipeline and the number of boosters.

These determine the pipeline costs. Thirdly, the type and location of the disposal area will determine the cost of earthwork construction and return lines. Fourthly, how is the volume of dredged sediment determined (engine hours, lake bottom profiles, or profiles of the disposal area) for payment? Additional costs will include engineering, environmental impact studies, permit acquisition, disposal land acquisition, project inspection, and management.

The method of production has several options. First, the state can buy equipment and run the project with it's own personnel. In general, government-run dredging operations are not cost effective. Second, the state could own the equipment and have a private contractor run the equipment. This requires a special, long-term relationship to guarantee that the equipment suits the contractor and that the equipment is well maintained for the state. Third, the state can use the usual bidding process with private dredging companies. The first few jobs will be costly as the state goes through the learning curve and the contractors bid high to protect themselves from a learning client. Other contractors may bid low but charge heavily for change orders or additions necessitated from design or contract deficiencies. Experienced dredge engineers and managers are a must to minimize costly change orders and additions. Fourth, the state could negotiate with one or more contractors for a total procurement package (engineering, permits, construction, and dredging) as is done by the federal government and by private projects. Instead of bid bonds, the job is phased with progress payments less a 10% retainer until job completion. A simpler form of this is negotiated contracts with qualified contractors who need to be pre-qualified by equipment and experience. Because of the lack of large portable dredges, contracts negotiated with 2 or 3 qualified contractors would probably produce the best competitive prices at the beginning.

A funding mechanism for the reservoir dredging must be set in place for long-term maintenance. Reservoirs like Tuttle Creek and Perry Lake are accumulating 4 to 6 million cubic yards each per year. With turn key dredging costs (dredging, pipelines, disposal area construction) running between $2 and $8 a cubic yard, the continued use of these reservoirs will not be free. Wildlife and recreational uses will not be able to justify such costs. Agriculture alone can not justify the use of water out of the dams. Cities and other major users (power plants, chemical plants, water districts) down stream could pay for the lion's share without a major increase in their total costs. This however would require legislative action.

SUMMARY

In assaying what other states are doing, several questions need to be asked. What are the total costs; not just the dredging (pipelines, boosters, disposal construction, engineering, permits, remediation)? What are the production levels and how are they determined? How far and to what elevation is the sediment transported? How was the volume of sediment determined (engine hours, bottom profiles, disposal area profiles)? Was the dredged material 100% silt or was there virgin material or rock dredged? How long did the work take and what permits were required? What equipment was used (dredge size, horsepower, type of pipeline)? How was the work contracted, executed, and supervised? Who did the engineering, contracting, and inspection? How was the work funded? Will the dredging maintenance sustain the storage capacity of the reservoir continue into the distant future? What is to be done with reservoirs that are allowed to fill up completely? What effect does this have on flood control and water supplies?