From:	Rambo, Carol
To:	ACT-WCM
Cc:	Hyland, Charles E.
Subject:	Public Comment re Draft EIS on ACT River Basin Water Control Manual submitted on behalf of Mobile Area Water & Sewer System
Date:	Friday, May 31, 2013 8:58:47 AM
Attachments:	Public Comment for Corps of Engineers 30may13.pdf

MOBILE AREA WATER & SEWER SYSTEM

May 30, 2013

Commander
U. S. Army Corps of Engineers
Mobile District
Attn: PD-EI (ACT-DEIS)
Post Office Box 2288
Mobile, AL 36628

RE: Draft Environmental Impact Statement
Update of the Alabama-Coosa-Tallapoosa River Basin Water Control Manual

To Whom It May Concern:

On behalf of the Mobile Area Water & Sewer System, I submit the attached comments on the Draft Environmental Impact Statement (EIS) issued in connection with the update of the Alabama-Coosa-Tallapoosa (ACT) River Basin Water Control Manual. The draft EIS and the draft master manual contain serious procedural, technical, and substantive flaws.

Sincerely,

Charles E. Hyland, Jr., Director

CEH/cr

Enclosure

P.O. Box 2368, Mobile, AL 36652 • 207 North Catherine Street • Mobile, AL 36604 • Phone 251.694.3100 • Fax 251.694.3448
www.mawss.com

My name is Charles E. Hyland, Jr. I am currently the Director of the Board of Water & Sewer Commissioners of the City of Mobile, having served in that position since March 2013. I served as Water & Sewer Administrator from 1990-2013, working in a variety of areas of the Mobile Area Water & Sewer System.

The attached documentation is related to the impact the diversion of waters that feed the ACT River Basin could potentially have on the Board of Water & Sewer Commissioners and our customers. This harm includes failure to be able to provide fresh water unencumbered with salt or brine from tidal and other influences of Mobile Bay for use in industrial processes and the diminishment of a standby source of drinking water for our residential and commercial customers.

This packet contains a short narrative, pictures of the canal used to transport water from Bucks to industrial customers, and information related to saltwater intrusion and the industrial water supply.

The Mobile Board provides water and waste water service to residential, commercial, and industrial customers in the Mobile Area, including Mobile County, Alabama and Baldwin County, Alabama. The Mobile Board's service area is downstream of the Alabama, Coosa and Tallapoosa River Basin ("ACT River Basin"). To reliably and lawfully operate its facilities, the Mobile Board is heavily dependent on reliable water from the ACT River Basin, particularly the Alabama River, which terminates into the Mobile River. In 1967, the Mobile Board constructed a water intake 30 miles upstream on the Mobile River (the terminus of the Alabama River) at Bucks, Alabama. The facility includes a protective structure and electrical and diesel powered pumps that elevate the water sufficiently to flow to a canal and pumping network, which was also constructed in 1967, that transports untreated raw water sixteen miles south to industrial customers. Intake and transport capacity exceeds ninety million gallons per day and is currently operating near 20 million gallons per day. Since 2002, this water intake also serves as standby source of water supply for municipal drinking water should a disaster or other emergency limit or prohibit the use of the Mobile Board's primary surface water impoundment located in another watershed.

The location of the water intake site at Bucks, Alabama was chosen for the express purpose of obtaining fresh water, unencumbered with salt or brine from tidal and other influences of Mobile Bay, for use in industrial processes. The Alabama River is the source of 90% of the Board's industrial water supply. Reduced flow of water in the Alabama River has recently allowed salty, brackish water from Mobile Bay to extend north of the Bucks intake. This intrusion is caused by the tidal action of salty Mobile Bay when the flow of fresh water in the Mobile River is too low to keep the denser Bay water from extending upriver. The encroachment of salt water upstream is directly related to the reducing volume of Mobile River flow. The result is that water now pumped from the River at the Bucks intake contains salt levels in excess of limits acceptable for some industrial uses. The extent of unacceptable, elevated salt concentration in the Mobile River at the Bucks intake site increases with reducing flow from the Alabama River and is adversely affecting the Mobile Board's operations and those of its industrial customers. In consequence of this, the ACT River Basin is of vital importance to the Mobile Board, and any action that diminishes water flows therein will cause increasing harm to the Mobile Board and its customers.

DEPARTMENT OF THE ARMY
S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

31 May 2007

CESAM-PD-EI
PUBLIC NOTICE NO. FP07-AC01-16

PUBLIC NOTICE
U. S. ARMY CORPS OF ENGINEERS
ALABAMA POWER COMPANY REQUEST FOR APPROVAL TO REDUCE MINIMUM FLOW ON ALABAMA RIVER

TO WHOM IT MAY CONCERN:

The U.S. Army Corps of Engineers (Corps), Mobile District, has received a request by the Alabama Power Company (APC) for a temporary modification of the minimum flow agreement between APC and the Corps for operation of their power project impoundments on the Tallapoosa and Coosa Rivers in conjunction with the Corps operations of the Federal projects in the Alabama and Coosa River Basins. The minimum flow agreement is required by the Federal Energy Regulatory Commission (FERC) licenses for the APC impoundments and also incorporated into the water control plans/manuals for the Corps projects. The APC request is in response to extreme low inflows and extended drought conditions experienced this year. This notice is requesting comments from Federal, State and local agencies, municipalities, affected industries, organizations and the public regarding potential affects of the proposed reduction in flows. Information provided in response to this notice will be considered by the Mobile District in determining whether or not to implement drought contingency operations under the Corps' current water control plans as requested by APC. Please communicate this information to interested parties.

WATERWAY: APC-owned lakes on tributaries to the Alabama River include Lakes Harris, Martin, Yates and Thurlow on the Tallapoosa River. On the Coosa River they include Lakes Weiss, H. Neely Henry, Logan Martin, Lay, Mitchell, Jordan/Bouldin. The Federal project reservoirs include Allatoona Dam and Lake on the Etowah River and Carters Dam and Lake on the Coosawattee (Coosa River basin) and Robert F. Henry Dam/R.E. "Bob" Woodruff Lake, Miller's Ferry Dam/William "Bill" Dannelly Lake, and Claiborne Dam and Lake on the Alabama River.

DROUGHT CONDITIONS: Monitoring of drought conditions this year has confirmed that Calendar Year 2007 is the driest year-to-date through May recorded in contemporary Alabama climate records. Some areas in the northern portions of the States of Alabama and Georgia have received no rainfall in the month of May. Severe to Extraordinary Drought conditions have developed across these areas. The January to May time period for 2007 is the driest in over 100 years for Alabama, Georgia, north Florida and portions of the Carolinas. Long-range computer models indicate no significant rainfall across the central Gulf States through early June.

APC PROPOSAL: Attached is a letter from the APC dated 15 May 2007 regarding a drought contingency proposal requesting approval by the Corps to reduce the overall total average release of water from APC reservoirs. This request would require a temporary modification to the minimum flow agreement between APC and the Corps. Under terms of the current minimum flow agreement, APC projects will provide sufficient releases from their Coosa and Tallapoosa River projects to meet a continuous minimum 7-day average flow of 4,640 cubic feet per second (cfs) (32,480 day second feet (dsf)). Additional intervening flow or releases from the Federal projects would provide usable depths for navigation or meet the 7Q10 flow of 6,600 cfs at Claiborne Dam downstream. APC is currently making the minimum releases from their projects to meet the 4,640 cfs requirement, but has expressed concern that the continued minimum release, if drought conditions and the extremely low inflows into the basin continue, could result in continued drawdown of their reservoirs to levels at or below their drought contingency curves. APC therefore requests consideration of proposal to reduce releases from their projects by phased increments as shown in their attached letter. The proposed reductions would be accomplished in four steps, reducing the flow by approximately 10% per week (or other appropriate time period), until the proposed minimum is achieved. The proposed minimum of 19,488 dsf would constitute a total 40% reduction in minimum flows previously agreed to by APC in the current minimum flow agreement.

The Alabama Office of Water Resources has requested information on how the Corps intends to operate Allatoona Lake and Carters Lake to help mitigate the current drought conditions. APC has also requested that the Corps provide additional releases from storage from the Allatoona and Carters projects to supplement the record low flows downstream of those projects. The specified minimum release for both Allatoona and Carters projects is 240 cfs; currently we are releasing up to 600 cfs from Allatoona and approximately 400 cfs from Carters.

EVALUATION OF REQUEST: The Corps is given discretion to manage its reservoirs by the Flood Control Act of 1944. The procedures for water management actions at Corps projects are set out in Engineer Regulation 1110-2-240 (33 C.F.R. Part 222.5), which states as follows in regard to droughts:

> "Continuous examination should be made of regulations schedules, possible need for storage reallocation (within existing authority and constraints) and to identify needed changes in normal regulation. Emphasis should be placed on evaluating conditions that could require deviation from normal release schedules as part of drought contingency plans (ER 1110-2-1941)."

Engineering Regulation 1110-2-1941 requires water managers to reexamine procedures and reservoirs to determine whether improvement can be made during low water periods within current authorities. Under this regulation, the Mobile District developed a drought contingency plan for the Robert F. Henry project located on the Alabama River first in line below the APC projects on the Coosa and Tallapoosa Rivers. This drought contingency plan for the Robert F. Henry project is found at Paragraph 7-10 of the Water Control Manual for the project. It states that the project is dependent on releases from the upstream APC projects to meet the authorized project purposes, which must be provided pursuant to their FERC licenses. Accordingly, the Mobile District and APC instituted a minimum flow agreement to provide for environmental protection and navigation flows on the lower river. The drought contingency plan allows a lesser amount to be released from the Federal projects as local flows diminish and storage is exhausted. However, the plan requires the users of the system, private industries, state agencies and federal agencies with interests in the system to be notified in advance of any reduction and given the opportunity to comment. The Mobile District can allow for reductions of the minimum flow agreement if such a change would aid in the total operation of the river system and provide the maximum benefits from any available water. As drought conditions develop, the Corps will provide routine press releases to the general public advising on operational and climatological conditions throughout the river basin. Also, public meetings may be conducted throughout the basin as necessary to keep agencies, major industries and the general public informed on impending conditions and to solicit comments regarding potential changes in project conditions.

POTENTIAL CONSEQUENCES OF PROPOSED ACTION: When drought conditions determine that a change in the operating guidelines is necessary, various users of the system will be notified so that environmental or operational preparations can be completed prior to any impending reductions. The Corps will also consider the impacts on the users of the system and consider environmental and operational concerns in reaching a determination on appropriate changes in operations. The proposed reductions in water releases from APC lakes as described above could include but not be limited to various impacts on the human and natural environment. The reduced flow from the Tallapoosa and Coosa Rivers would result in reduced flow on the lower Alabama and Mobile Rivers and lower lake levels in the downstream Federal reservoirs unless augmented by increased releases from the upstream Corps reservoirs within the river basin. Such reductions could have downstream impacts to users of the waterway, while increased releases from Corps lakes higher in the basin could have impacts to those users. In addition, reduced flows on the Alabama River system are only partially mitigated by flows from the Tombigbee system since approximately two-third of the flow into the Mobile River comes from the Alabama River system during low flow conditions compared to approximately one-third from the Tombigbee River system.

APC indicates that their storage projects on the Coosa and Tallapoosa are all below their drought contingency curve peak elevations. With inflows at record lows on the Coosa and Tallapoosa, the impact of maintaining a release of 4,640 cfs to the Alabama River has fallen completely on the remaining storage at Lake Martin. If the proposed reductions are not implemented, APC has indicated that the Coosa River projects would be drawn down to their winter levels and Lake Martin is projected to be 14 feet below the rule curve by early August. This drawdown at Lake Martin would have adverse impacts on the water intakes on the lake. APC's analysis indicates that if this drought continues unabated they are in danger of losing all generating capability at Weiss, Neely Henry and Logan Martin Dams as water levels become too low to operate the turbines. APC is concerned that without sufficient releases from the upstream

Corps storage projects they could see these levels before the end of the summer. APC states that the loss of this generation would severely impact the reliability of the electric system.

If APC's proposal is fully implemented, river levels could fall below elevation 4 feet on the Claiborne Dam tailwater. This represents a reduction of the 4,640 cfs flow to 2,784 cfs flow. The reduction in flow could represent less hours of generation from R.F. Henry and Millers Ferry projects, reduce navigation channel depths on the Alabama River, adversely impact waterborne recreation, and may affect the assimilative capacity for industrial and municipal users. The flow reduction could also potentially affect flows, water quality, salt water intrusion, and environmental resources in the Mobile Delta and Bay area.

PUBLIC COMMENTS: This public notice is being distributed to all known interested persons in order to assist in developing facts on which a decision by the Corps can be based. The decision on the appropriate drought contingency operations will be based on an evaluation of the probable impact, including cumulative impacts, of the proposed activity on the public interest. Comments are requested on specific impacts to other users and operations that occur within the basin. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered, including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, flood plain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food production, and in general, the needs and welfare of the people.

The Corps is soliciting comments from the public; Federal, State, and local agencies and officials; Indian Tribes; industries; and other interested parties in order to consider and evaluate the impacts of this proposed activity.

Correspondence concerning the proposed reduction in flows as proposed by APC and should be directed to the District Engineer, U.S. Army Engineer District, Mobile, Post Office Box 2288, Mobile, Alabama 36628-0001, Attention: Planning and Environmental Division, in time to be received not later than **10 calendar days after the date of this notice**. Comments may also be emailed or faxed to Mr. Chuck Sumner, Inland Environment Team, FAX: (251) 694-3815, Email: lewis.c.sumner@sam.usacae.army.mil. Questions concerning this public notice may be directed to Mr. Sumner at (251) 694-3857.

MOBILE DISTRICT
U.S. Army Corps of Engineers

Georgia Department of Natural Resources
2 Martin Luther King Jr. Drive, Suite 1152 East Tower, Atlanta, Georgia 30334
Noel Holcomb, Commissioner
Carol A. Couch, Ph.D., Director
Environmental Protection Division
(404) 656-4713

June 8, 2007

By Email, Fax and Overnight Delivery
Colonel Peter Taylor
District Engineer
U.S. Army Corps of Engineers, Mobile District
P.O. Box 2288
Mobile, Alabama 36628-0001
Attention: Planning and Environmental Division

Re: Alabama Power Request for Approval to Reduce Minimum Flow on Alabama River and for Additional Releases from Allatoona and Carters

Dear Colonel Taylor:

The State of Georgia provides these comments to the Corps' Notice of May 31, 2007 of a request by Alabama Power for a temporary reduction of the 4,640 cfs 7-day average minimum flow that Alabama Power maintains in the Alabama River downstream of its Coosa and Tallapoosa projects for navigation purposes. According to your Notice, in addition to this request, Alabama Power also is requesting that the Corps "provide additional releases from storage from the Allatoona and Carters projects to supplement the record low flows downstream" of the Alabama Power projects. The Notice did not provide any information on the amount of additional releases that Alabama Power had requested.

As to the reduction of the 7-day average flow of 4,640 cubic feet per second (cfs) from the Alabama Power projects for navigation purposes, Georgia does not oppose it. In fact, in light of the extreme drought conditions that exist within the ACT Basin in Georgia and in Alabama, Georgia believes that it is prudent if not imperative that the flow requirement be reduced or temporarily suspended until drought conditions improve.

Georgia is strongly opposed, however, to the Corps' increasing releases above current levels or above levels that are called for under the Corps' drought contingency plans for Lake Allatoona and Carters Lake, for the purpose of providing additional augmentation for the Alabama Power reservoirs, for the following reasons:

1. Georgia relies upon Lake Allatoona and Carters Lake to provide water supply to approximately .5 million people. Protection of these water resources is vitally important to the State and the region.

2. The ACT Basin within Georgia is suffering from extreme drought conditions. May 2007 inflows to Lake Allatoona and Carters were at record lows. Inflows to Allatoona and Carters in May 2007 were 596 cfs and 158 cfs respectively, substantially below the prior record lows of 789 cfs and 252 cfs, respectively, during May 1986. (Note that these are honest and fair comparisons. We have adjusted inflows to eliminate any impacts of consumption.) Unlike the Alabama Power reservoirs, Lakes Allatoona and Carters are located near the headwaters of the basin, have small drainage areas relative to conservation storage, and have a more limited opportunity for refill. Given these conditions, the Corps must be conservative in making releases from Allatoona and Carters.

3. Under the Corps' existing drought contingency procedures for Lake Allatoona, releases from the lake should be decreasing, not increasing, as drought conditions worsen. Allatoona would have to bear most of the burden if the Corps were to provide augmenting releases from the federal reservoirs, and there is nothing in the Corps' authorities or in its plans or guidance for Lake Allatoona to support what Alabama Power is proposing. That the Corps would alter its standard operations in response to such a request further underscores the need for the Corps to keep current and operate in adherence with water control plans.

4. An analysis of the effects of potential augmentation from Allatoona and Carters illustrates the catastrophic effect that it would have on the federal reservoirs. By email dated June 5, 2007, the Assistant Chief, Operations Division for the Corps' Mobile District informed us that the Corps was modeling two augmentation scenarios: one in which the minimum daily release from Allatoona is 565 cfs and the minimum daily release from Carters is 380 cfs (we will call this "Alternative 1"); and another in which the minimum daily release from Allatoona is 890 cfs and the minimum daily release from Carters is 518 cfs (we will call this "Alternative 2"). (We take it that the Corps has suggested that these be modeled to illustrate the effects on the reservoirs and for no other reason, as there is absolutely no resource-based justification for making releases in these amounts.) We modeled these alternatives, as well as a scenario in which the Corps releases the minimum at-site requirement for each reservoir of 240 cfs (which is less than the Corps currently is releasing). We modeled all three scenarios during the drought period of 1986-1988, the drought of record, which is reasonable given that this year's conditions are shaping up to be as bad or worse than that period, and assumed year 2005 water demands. The modeling, as shown in the attached graphs, reveals that providing such augmenting releases from Allatoona and Carters has devastating effects on the federal reservoirs but does not benefit the Alabama Power reservoirs:

(a) Today's reservoir levels resemble those shown for the same time of year (early June) in 1987 under the scenario in which 240 cfs is the minimum release (this scenario is shown in blue on the graph). If the Corps continues releasing 240 cfs, the level in Lake Allatoona still would fall precipitously throughout the summer.

(b) Operating pursuant to Alternative 1, shown in yellow on the attached graph, would deplete all conservation storage, effectively emptying Lake Allatoona by January of 1988 (or January of next year, if hydrologic conditions track or are worse than in 1987-88). Lake Allatoona would not refill in the spring/summer of 1988 and would be emptied again in the summer of 1988. Carters would fall to as low as 1065 feet in January 1988 and approximately 1061 feet in the fall of 1988.

(c) Operating pursuant to Alternative 2 would empty Lake Allatoona for the same periods, although more rapidly, and would draw Carters down to 1050 feet in October 1986 and December-January of 1988, and below 1030 feet in January 1989.

(d) The elevations of Alabama Power's Lake Weiss, H. Neely Henry, and Logan Martin are not significantly improved by the increased releases under Alternative 1 or Alternative 2. The elevations produced by those alternatives are virtually indistinguishable from the scenario in which the Corps releases 240 cfs from Allatoona and Carters. The instances in which elevations of the Alabama Power reservoirs are lower under the 240 cfs-release scenario are offset by other times in which Alternative 1 and Alternative 2 produce lower elevations for the Alabama Power reservoirs (due to the emptying of the federal reservoirs upstream).

5. Alabama Power has not demonstrated any valid resource-based need for greater augmentation from Allatoona and Carters:

(a) Contrary to the representations contained in Alabama Power's email to me dated June 6, 2007 (attached), the levels of the Alabama Power reservoirs are *not* at record lows. As of June 7, 2007, the elevation of Weiss Lake was 562.42, several feet above its record low and above its historical June low. As of June 7, 2007, the elevation of Neely Henry was 507.08 feet, also above its all-time low and above its historical low for June of 506.2 feet. While Logan Martin is below its historical low for June, it is above its all-time historical low, and its elevation can be manipulated by releases from storage from the Alabama Power reservoirs upstream. (As discussed below, because Alabama Power refuses to provide us with hydropower and release information for Logan Martin and the other reservoirs, we cannot evaluate why Alabama Power has drawn down Logan Martin proportionately more than its other reservoirs.)

(b) By letter dated June 5, 2007, I requested information from Alabama Power concerning reservoir elevations, hydropower generation, and releases from the Alabama Power reservoirs. The purpose for this request was to allow Georgia and others to better evaluate how the Alabama Power reservoirs are and have been operated, why they are at their current levels, and what those current elevations mean. Alabama Power refused to provide this information and dismissed the request as not relevant. A copy of my letter to Alabama Power and the email that I received in response are attached. Mr. Bowers' response is totally unacceptable given the drastic relief that Alabama Power Company is requesting, the effect upon Georgia that this could have, and the lack of any apparent actual benefit to the Alabama Power reservoirs. While we were able to obtain some reservoir elevation information from Alabama Power's website, we were unable to gather all of the information that is needed to evaluate the status of the Alabama Power reservoirs. Alabama Power's claims about its reservoirs and its request for augmentation from the federal reservoirs lack credibility when Alabama Power is withholding information relevant to the basis for its request.

6. Most importantly, while we do not know precisely what quantity of augmentation that Alabama has in mind, we know that increasing releases from Lake Allatoona and Carters Lake is

not likely to improve conditions in the Alabama Power reservoirs or downstream of them. This is illustrated by the above modeling and cannot be over-emphasized. The net increase of releases from the federal reservoirs will constitute a small percentage of the inflows of the Alabama Power projects and will not markedly improve reservoir elevations on a sustainable basis. Releasing too much water now, on the other hand, could deplete the storage of the federal reservoirs, resulting in lower (even zero) releases in the future and lower elevations in the Alabama Power reservoirs. The large releases depicted in the models, while emptying Lake Allatoona, do not help the Alabama Power reservoirs. And, if the Corps releases less than that, in an effort to augment the Alabama Power projects without emptying Lake Allatoona, it still will deplete precious headwater storage without providing any discernable benefit to the Alabama Power projects or flows downstream of them.

In closing, it should be noted that Georgia is doing its part to "share the pain" of the current drought with its downstream neighbors and is responsibly managing its scarce water resources. We have declared a Level 2 drought in Georgia, resulting in tight outdoor water use restrictions. Within northwest Georgia, many local governments have voluntarily imposed even more stringent water use restrictions. We will keep these measures in place for as long as necessary, until drought conditions improve.

In light of the foregoing, we request that you grant a reduction in the applicable minimum flow below the Alabama Power projects, but that you refrain from increasing releases from Allatoona and Carters reservoirs above current levels or levels dictated under appropriate drought contingency procedures for the federal reservoirs.

Sincerely,

Carol A. Couch
Director

CAC:ypf

cc: Brig. Gen. Joseph Shroedel, South Atlantic Division Commander, U.S. Army Corps of Engineers
Willard Bowers, Vice President, Environmental Affairs, Alabama Power Company
Mr. Chuck Sumner, Inland Environment Team, U.S. Army Corps of Engineers, Mobile District

Table 1. Simulation Alternative

Color of Curves	Alternative
Blue (Current operation)	The required minimum flow from Carters and Allatoona is 240 cfs
Orange (Alternative 1)	The required minimum flows from Carters and Allatoona are 380 and 565 cfs respectively
Red (Alternative 2)	The required minimum flows from Carters and Allatoona are 518 and 890 cfs respectively

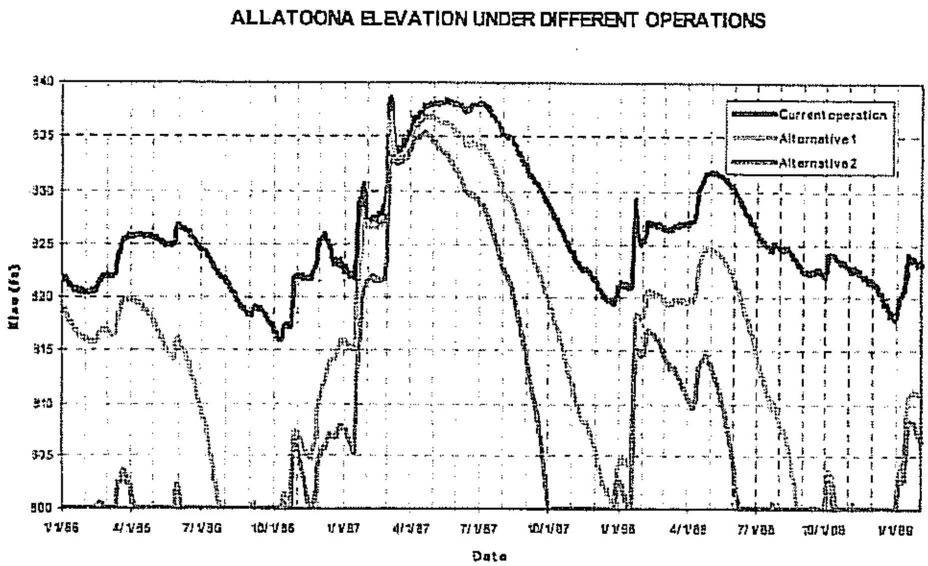

Fig.1 Simulated Lake Allatoona Elevation for the Drought Period 1986-1988

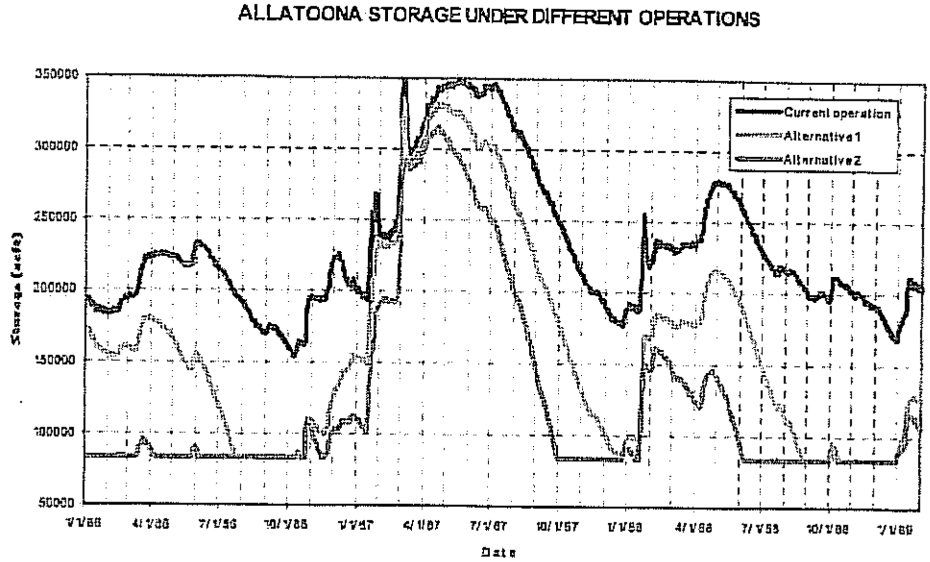

Fig.2 Simulated Lake Allatoona Storage for the Drought Period 1986-1988

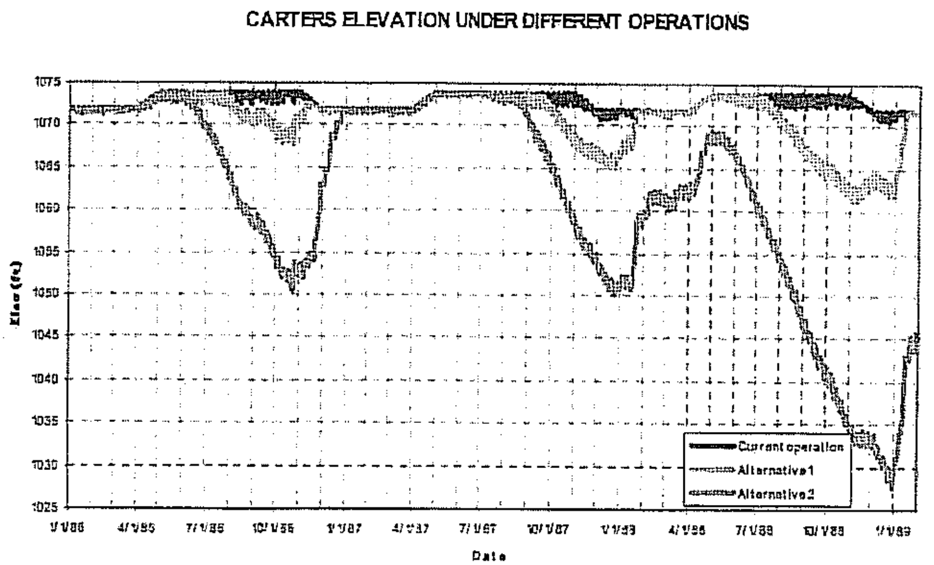

Fig.3 Simulated Carters Elevation for the Drought Period 1986-1988

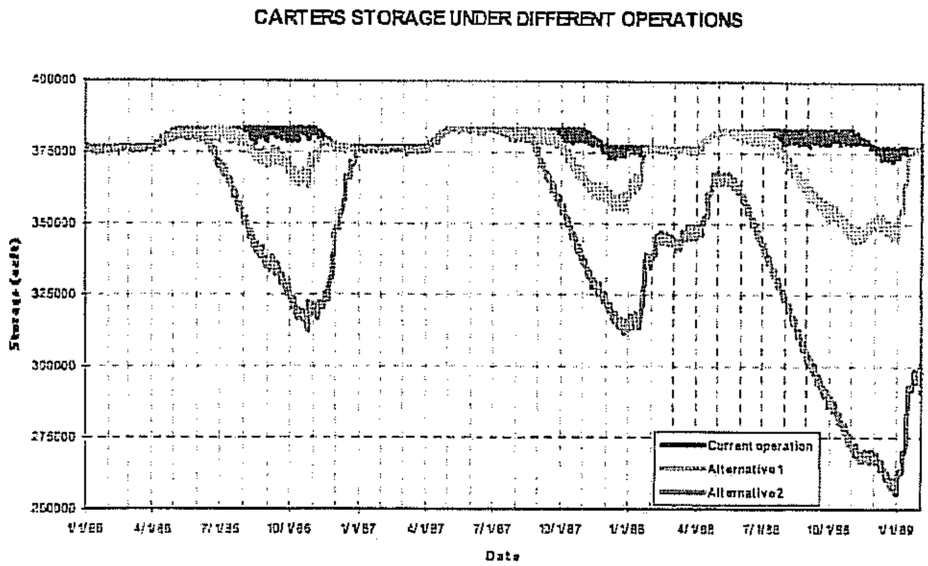

Fig.4 Simulated Carters Storage for the Drought Period 1986-1988

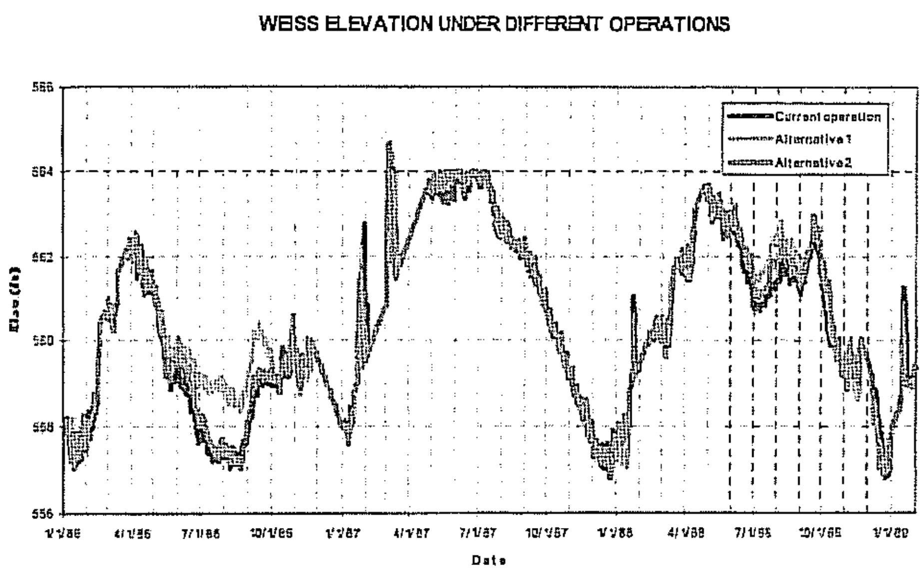

Fig.5 Simulated Weiss Elevation for the Drought Period 1986-1988

H.N. HENRY ELEVATION UNDER DIFFERENT OPERATIONS

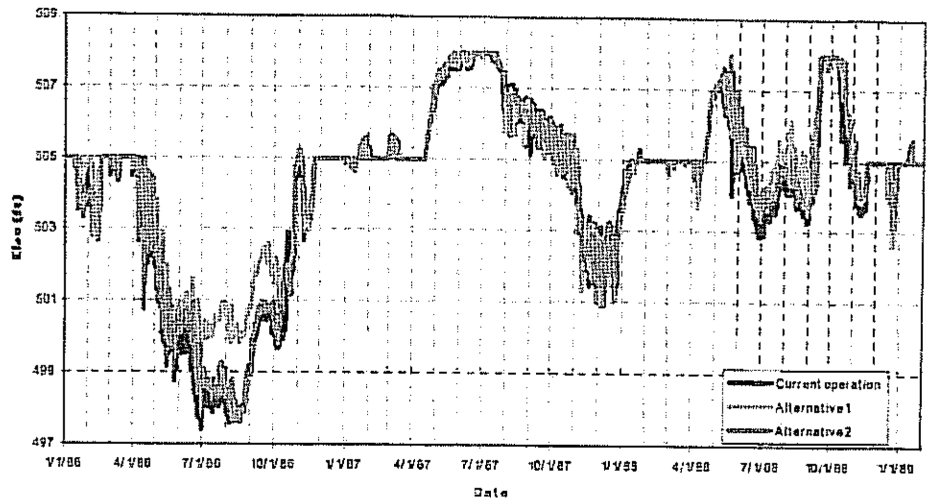

Fig.6 Simulated H.N.Henry Elevation for the Drought Period 1986-1988

LOGAN MARTIN ELEVATION UNDER DIFFERENT OPERATIONS

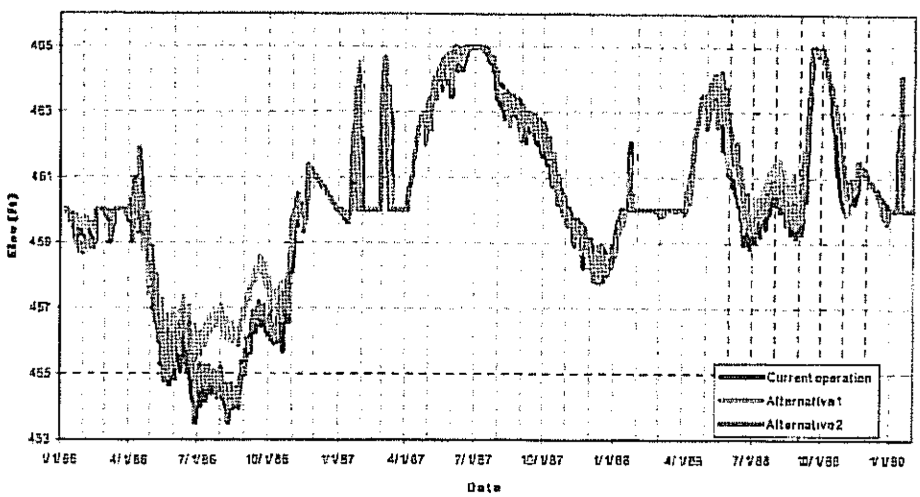

Fig.7 Simulated Logan Martin Elevation for the Dro

Georgia Department of Natural Resources
2 Martin Luther King Jr. Drive, Suite 1152 East Tower, Atlanta, Georgia 30334
Noel Holcomb, Commissioner
Carol A. Couch, Ph.D., Director
Environmental Protection Division
(404) 656-4713

June 4, 2007

By Email, Fax and Overnight Delivery
Willard L. Bowers
Vice President, Environmental Affairs
Alabama Power Company
600 North 18th Street / 12N-0830
P.O. Box 2641
Birmingham, Alabama 35291

Re: Alabama Power Coosa and Tallapoosa Projects

Dear Mr. Bowers:

The State of Georgia has received Alabama Power's proposal for a temporary reduction of the minimum flow agreement between Alabama Power Company and the Corps of Engineers for the Alabama River below Alabama Power's Coosa and Tallapoosa projects. We understand that in conjunction with this request, Alabama Power also is requesting that the Corps increase current releases from Lake Allatoona and Carters Lake in order to provide additional inflow to the Alabama Power projects.

Given the serious drought conditions within the ACT Basin in Georgia this year, Georgia is very concerned about the prospect of the Corps making greater releases from federal reservoirs in the headwaters of the ACT Basin in an effort to raise APC reservoir levels downstream, where inflows and storage capacity are much greater, and the probability of refiling comparatively greater as well. Georgia is carefully reviewing the request and will make comments to the Corps regarding the risks incurred as a result of its implementation.

To assist Georgia in understanding and evaluating Alabama Power's proposed action, we request additional information on historical and current conditions of the Alabama Power projects, specifically as follows:

1. Daily time series pool elevations for the Alabama Power projects on the Coosa and Tallapoosa Rivers since each was placed into operation, up to May 31, 2007.

2. Daily time series power generation for the Alabama Power Coosa and Tallapoosa projects for the same period of record.

3. Daily time series releases for the Alabama Power Coosa and Tallapoosa projects for the same period of record.

4. Historical and/or projected annual pool evaluation duration data from Alabama Power Coosa and Tallapoosa River projects developed in connection with FERC relicensing applications.

Because the Corps has imposed a June 10 deadline on submission of comments on the Alabama Power proposal, this information is needed urgently and quickly. The information should be readily available to you, and you should be able to transmit it to me promptly without undue burden. I would appreciate your providing me with this information by no later than close of business on Wednesday, June 6, 2007. If you cannot provide it to me by then, I would ask that you join me in requesting that the Corps extend the time for Georgia to provide comments on the flow reduction request and that the Corps take no action on the request in the meantime.

Thank you for your assistance.

Sincerely,

Carol Couch
Director

cc: Brig. Gen. Joseph Shroedel, South Atlantic Division Commander, U.S. Army Corps of Engineers
Colonel Peter Taylor, District Commander, U.S. Army Corps of Engineers, Mobile District
Mr. Chuck Sumner, Inland Environment Team, U.S. Army Corps of Engineers, Mobile District

From: "Bowers, Willard L." <WLBOWERS@southernco.com>
To: <ccouch@dnr.state.ga.us>
Date: 6/6/2007 4:12 pm
Subject: Re: Alabama Power Coosa and Tallapoosa Projects - Letter datedJune 4, 2007

CC: <jturner@gov.state.ga.us>, <tsilliman@mckennalo...

Dr Couch,

I have reviewd your letter with my staff and considered your request in light of the current situation. This drought is approaching and will likely establish new records in all aspects of streamflow across the Mobile River Basin. In response to these situations we began reducing releases to minimum levels in February from both our Coosa and Tallapoosa River projects. We were able to bring our Coosa projects to full pool levels by obtaining a variance from the Corp of Engineers. We were unable to fill our Tallapoosa projects even though releases were at a minimum level.

We are still operating at minimum release levels which require 2000 cfs from our Coosa projects to protect the endangered Tulatoma Magnifica and a combination of releases from our Coosa and Tallapoosa projects of 4640 cfs for navigation on the Alabama River. Simply stated this is requiring 2000 cfs from the Coosa and 2640 from the Tallapoosa.

Currently the basin wide inflows for the Coosa and Tallapoosa are 1530 cfs and 185 cfs respectively. Both these continue to fall. Thus, to maintain the minimum flows will require increasing utilization of the storage on both systems. We are projecting that we will be below winter pool levels on all our projects by mid July.

Contrary to your letter, the purpose of our request is not to refill the Alabama Power reservoirs but rather to decrease the rate of drop in reservoir levels. We have requested a reduction in the minimum flow on the
Alabama River and an increse in releases from Allatoona and Carters for that reason. Our reservoirs are at all time record lows and we have depleted over 25 percent of our storage on the Coosa. Meanwhile, Carters and Allatoona contain approximately 300,000 cfs-days of storage.

You requested historical information of daily reservoir elevations, releases, and generation for the period from when our projects were constructed to present. That information is not readily available and we do not understand why it is needed to evaluate a drought condition. I am not going to divert staff time to gather it. You can obtain current informatiion on our projects from the web site http://www.alabamapower.com/lakes/lakeinfo.asp.

Your letter requested that I join you in asking for an extension of the comment period and asking that the Corp take no action if we could not provide the data by close of business today. Given the lack of revelence of the information requested to the evaluation of current conditions, I will not request an extension of the comment period or request that the Corp delay taking action.

Respectfully,

Willard L Bowers

Willard Bowers

-----Original Message-----
From: Carol Couch <ccouch@dnr.state.ga.us>
To: Bowers, Willard L.
CC: jturner@gov.state.ga.us <jturner@gov.state.ga.us>; Todd Silliman <tsilliman@mckennalong.com>;

peter.f.taylor.col@sam.usace.army.mil <peter.f.taylor.col@sam.usace.army.mil>;
joseph.schroedel@usace.army.mil <joseph.schroedel@usace.army.mil>
Sent: Tue Jun 05 10:19:14 2007
Subject: Alabama Power Coosa and Tallapoosa Projects - Letter datedJune 4, 2007

600 North 18th Street
Post Office Box 2641
Birmingham, Alabama 35291

Tel 205.257.1000

June 11, 2007

ALABAMA POWER
A SOUTHERN COMPANY

BY EMAIL

Colonel Pete Taylor
District Engineer
C/O Planning & Environmental Division
U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, AL 36628-0001

Re: **May 31, 2007, Public Notice No. FP07-AC01-16 Concerning Alabama Power Company's Request for Approval to Reduce Minimum Flow on Alabama River**

Dear Colonel Taylor:

We are in receipt of your May 31, 2007 public notice No. FP07-AC01-16 concerning Alabama Power Company's proposal to temporarily reduce minimum navigation flow releases from the Company's Tallapoosa and Coosa River projects. Alabama Power's proposal also requested the Corps to increase releases from its Allatoona and Carters projects in response to the present exceptional/extreme drought conditions (the "Public Notice").[1] The requested downstream flow reductions and increased flows from Allatoona and Carters are critical to maintaining the reliability of Alabama Power's electric system, and to postponing and, thereby, hopefully avoiding catastrophic impacts downstream later in the summer. Alabama Power offers the following comments in response to the Public Notice:[2]

The Alabama-Coosa-Tallapoosa ("ACT") River Basin is currently experiencing historic drought conditions. On June 7, 2007, the U.S. Drought Monitor released its weekly report indicating that much of the Alabama portion of the ACT Basin is in the midst of an "exceptional" or "extreme" drought.[3] On June 8, Governor Bob Riley announced drought emergencies for 19 counties in north and central Alabama and has requested a federal disaster declaration to make farmers eligible for aid. The Governor's actions come after the Alabama Office of Water Resources issued a new advisory declaring severe drought conditions throughout the state. Flows in the Coosa River at the Alabama-Georgia state line, as measured at the

[1] Alabama Power's request included a minimum additional release of 1,000 cfs from storage from Allatoona and Carters. *See* Attachment A (May 29, 2007 e-mail from Charles Stover to Doug Otto).

[2] The Public Notice requested comments within 10 calendar days. This period ended on Sunday June 10, 2007, and we confirmed by phone with Mr. Chuck Sumner that these comments would be accepted if submitted today.

[3] *See* Attachment B (U.S. Drought Monitor reports for U.S. Southeast and Alabama, released June 7, 2007).

Mayo's Bar gage, reached an all-time low of 848 cfs on June 5, 2007.[4] That is more than 870 cfs below the previous all-time low for the month of June and is only 42% of the 7Q10 flow for June of 2,010 cfs.

Alabama Power operates 11 projects in the basin, and each project is well below not only its normal condition for this time of year, but below historic experience as well. Each of Alabama Power's hydropower facilities operate under operating licenses issued by the Federal Energy Regulatory Commission ("FERC"). Alabama Power's ACT hydropower facilities rely on adequate water levels in Alabama Power's reservoirs for hydropower production, and adequate water flows in the Coosa and Tallapoosa Rivers to replenish reservoir levels. Without adequate water levels in these reservoirs and the capacity to generate hydropower from Alabama Power's facilities, the entire Alabama Power electrical grid could be undermined, increasing the risk of brownouts and blackouts.[5] Alabama Power reservoirs also provide storage for water supply and for releases to support downstream flows.

As the attached graphs illustrate, the drought has had tremendous impacts on Alabama Power's reservoirs.[6] Lake Martin is already 6 feet below full pool, and if current conditions continue, and only minimum flows are released from Carters and Allatoona, Lake Martin will be at winter pool levels by approximately July 14, and Alabama Power's other Tallapoosa and Coosa River reservoirs will drop below winter pool levels by approximately July 27.[7] In contrast, the elevation at Allatoona Reservoir currently is above 837 feet—just 3 feet below full pool and 14 feet above winter pool in a reservoir containing 40 feet of storage.[8]

This historic drought has severely limited local inflows into Alabama Power's reservoirs. Exacerbating the stress on the reservoirs, however, are the minimum flows that continue to be released from those projects. The minimum flows are driven by a variety of considerations and obligations, and the one expressly at issue here is the "navigation flow" aggregate releases from the Coosa projects and Lake Martin of 4,640 cfs. In light of the drought, without increased releases from Allatoona and Carters, Alabama Power will be physically unable to continue to

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[5] *See* Attachment D (statement of Ronald G. Parsons, Transmission Interconnections & Operations, Alabama Power Company).

[6] *See* Attachment E (graphs showing elevation and rule curves for Alabama Power's Weiss, Henry, Logan Martin, Harris, Martin and Smith reservoirs).

[7] *See* Attachment F (containing operating plan summary for 2007 drought identifying basic projections for future operations based on minimum releases from Allatoona and Carters and the continuation of the 4,640 cfs minimum navigation flow requirement). Attachment F also contains a timeline of actions taken during 2007 to date.

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support navigation flows of 4,640 cfs through the summer. Reduction of navigation flow requirements, along with increased releases for Carters and Allatoona, is essential to managing the remaining storage in the ACT reservoirs for the duration of the present drought.

The proposed reduction of navigation flows set forth in Mr. Willard Bowers' letter of May 15, 2007, attached as an exhibit to the Public Notice, is based on the understanding that the Corps has not committed to release more than the minimum at-site requirements of 240 cfs from Allatoona and Carters Lakes regardless of conditions downstream. Approximately 60% of the flow being released into the Alabama River is from storage in Alabama Power reservoirs. As the drought grinds on, this proportion increases. In view of this, we maintain that at least a 40% reduction in navigation flows is an appropriate and necessary response. This level of response is not unprecedented. During both the 1986 and 1988 droughts, the navigation flows in the Alabama River were reduced by more than 40%.

As indicated in your Public Notice, the Corps has increased releases to approximately 600 cfs from Allatoona and 400 cfs from Carters. Despite these modest increases in releases from Allatoona and Carters since our letter of May 15, 2007, and without relief from the "navigation flow" requirement, Alabama Power's reservoir storage has continued to deteriorate. Even at the stated total releases of 1,000 cfs in combination from Allatoona and Carters, Lake Martin has dropped to 6 feet below full pool. In addition, without relief, water levels will drop to levels that endanger both the Alexander City and Coosa-Elmore Water Authority's water intakes in Lake Martin at elevation 475 and the Wedowee intake in Lake Harris at 783. In order to prevent the loss of these three intakes and further problems downstream of Thurlow for the remainder of the year, Alabama Power cannot draw Lake Harris below 785 and Lake Martin below 478.5. As that threat approached, Alabama Power would be forced to put greater strains on its Coosa River reservoirs to meet the current 4,640 cfs navigation flow minimum. In that case, Alabama Power's Coosa River reservoirs would quickly be pulled down well below winter pool levels, threatening the stability and reliability of Alabama Power's electric generating system, as well as other municipal and industrial water supply intake structures. With only minimum releases from Carters and Allatoona and with no reduction of the 4,640 cfs, this catastrophe could occur before the end of August. Once Alabama Power's reservoirs reached this point, it would be impossible to maintain all but the 2,000 cfs minimum flows required from Jordan for endangered species. This flow would also quickly become impossible to meet.

Alabama Power recognizes the Corps' concerns regarding water quality and assimilative capacity for municipal and industrial water users downstream from Alabama Power's reservoirs.[9]

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ALABAMA POWER
A SOUTHERN COMPANY

June 11, 2007

BY EMAIL

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District Engineer
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The Alabama-Coosa-Tallapoosa ("ACT") River Basin is currently experiencing historic drought conditions. On June 7, 2007, the U.S. Drought Monitor released its weekly report indicating that much of the Alabama portion of the ACT Basin is in the midst of an "exceptional" or "extreme" drought.[3] On June 8, Governor Bob Riley announced drought emergencies for 19 counties in north and central Alabama and has requested a federal disaster declaration to make farmers eligible for aid. The Governor's actions come after the Alabama Office of Water Resources issued a new advisory declaring severe drought conditions throughout the state. Flows in the Coosa River at the Alabama-Georgia state line, as measured at the

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As the attached graphs illustrate, the drought has had tremendous impacts on Alabama Power's reservoirs.[6] Lake Martin is already 6 feet below full pool, and if current conditions continue, and only minimum flows are released from Carters and Allatoona, Lake Martin will be at winter pool levels by approximately July 14, and Alabama Power's other Tallapoosa and Coosa River reservoirs will drop below winter pool levels by approximately July 27.[7] In contrast, the elevation at Allatoona Reservoir currently is above 837 feet—just 3 feet below full pool and 14 feet above winter pool in a reservoir containing 40 feet of storage.[8]

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These are important issues. Many Alabama stakeholders share these concerns as well. However, as mentioned above, if present conditions continue, navigation flows of 4,640 cfs cannot physically be maintained. The drought conditions will eventually force the reduction of those flows and the consequences to downstream interests will arise in any event. Reduced navigation flows, coupled with increased releases from Allatoona and Carters, will help sustain downstream water conditions better than abruptly eliminating flows later in the summer when the physical capacity of the ACT reservoir system runs out. In other words, it is a mistake to compare the consequences of reduced flows with "no drought" conditions. The drought is real and severe, and, so, the Corps should compare the proposed management changes with the alternative that in late summer, the system may fail to function and downstream flows will no longer be supported by the reservoirs at all.

With these considerations in mind, Alabama Power recommends that the Corps approve its proposal to reduce the navigation releases and to increase releases from Carters and Allatoona to be implemented as follows: as a reasonable first step response, an immediate reduction of navigation flow releases by 10% should be allowed, followed one week later by an additional 10% reduction, combined with releases by the Corps of at least 1,000 cfs from the storage of Allatoona Reservoir and Carters Lake. Alabama Power believes that this would be an adequate <u>first step</u> in responding to the extreme drought conditions suffered throughout the ACT Basin. Under current conditions, these changes would stretch storage in the Coosa and Tallapoosa projects to November, when seasonal rains are more likely. However, navigation flow releases and releases from Allatoona and Carters would have to be reconsidered continually during the drought to make necessary modifications as conditions require. If conditions continue to deteriorate, greater reductions in navigation flows and/or increased releases from Allatoona and Carters will be needed to protect various municipal and industrial entities' intake structures and, ultimately, the viability of Alabama Power's hydropower projects to maintain electric service. Alabama Power would adjust the future navigation releases as conditions warrant (after notice to the Corps and stakeholders sufficient to provide an opportunity to prepare for further changes) in proportion to future changes in inflows to the system.

Importantly, Alabama Power believes that additional releases from Allatoona and Carters would be entirely consistent with the Corps' operational manuals for both reservoirs. In fact, according to the Corps' 1993 draft reservoir regulation manual for Allatoona, which the Corps has said that it is following, the Corps should have made releases for at least two hours of hydropower generation each weekday in addition to a continuous release of 240 cfs. During May 2007, the elevation of Lake Allatoona was above 836′ at all times,[10] which is in Allatoona's Zone 1 for the month of May. According to Chart 1-11 in the 1993 draft manual for Allatoona, under such conditions the Corps is to make "normal conservation releases of water" in an amount "equivalent to between two and six hours of full powerhouse generation." Moreover,

[10] *See* Attachment G.

when Allatoona falls into Zone 2, the Corps is to make releases for two hours peak hydropower generation each weekday, plus maintain a continuous release of 240 cfs. Based on our review of the hydropower generation records for Allatoona Reservoir for May 2007, the Corps has not followed the guidelines contained in the draft manual. Had the Corps followed its guidelines, the average daily flow would have been considerably above the minimal releases made from Allatoona and Carters Lake during the month of May. This is also consistent with a basin-wide response to an exceptional/extreme drought.

Alabama Power is also providing information regarding potential water quality impacts to Weiss Lake. On November 1, 2004, the U.S. Environmental Protection Agency established a Total Maximum Daily Load ("TMDL") for nutrients in Lake Weiss.[11] Water quality modeling conducted at Weiss indicated that algae productivity in Lake Weiss increases with the retention time of the lake. As indicated in the attached documentation,[12] the retention time of Weiss Lake so far this year is approximately twice as long as the worst case conditions used in the TMDL modeling. Unless inflows are increased, this high retention time will likely result in very high algal growth and deterioration of water quality in the reservoir. Moreover, this deterioration will likely be exacerbated this year because nutrients (*e.g.*, Phosphorus) entering the reservoir during the spring (March – May) are normally moved through the reservoir rather quickly. However, this year instead of moving through the reservoir in 1-2 weeks, the retention time increased almost three fold to 46 days. Without increased inflows into Weiss Lake, extremely high eutrophication is likely, increasing the possibility of significant fish kills.

Lastly, Alabama Power's proposal is consistent with the primary purposes of Allatoona and Carters Lakes, which were both authorized and constructed for navigation, hydropower production and flood control. The legislative history of the Congressional actions authorizing both projects, as well as the Corps' own manuals and plans, clearly indicate that these primary purposes are to be reached through close coordination with Alabama Power's reservoir operations, and that the operation of both federal reservoirs was intended to aid the production of hydropower at Alabama Power's dams.[13] Indeed, Alabama Power has paid significant headwater benefits to the U.S. Treasury to pay for the construction, operation and maintenance of both federal reservoirs.

In conclusion, we ask that the Corps approve Alabama Power's proposal to temporarily reduce minimum navigation flow releases from our Tallapoosa and Coosa River reservoirs and for the Corps to increase releases from Allatoona and Carters to relieve the severe drought conditions in Alabama. Under present conditions, the ACT reservoir system would fail before

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[11] *See* Attachment H (U.S. EPA approval of TMDLs for Weiss Lake).

[12] *See* Attachment I (indicating comparative date concerning flows into Weiss Lake and retention time).

[13] The Allatoona and Carters reservoirs are located in Georgia, but the Corps' projects are to be operated in a manner to best manage the resources of the ACT Basin as a whole.

the end of the summer, during the driest period of the year. It is prudent to take steps to preserve the system until seasonal rainfall can he expected to increase toward the end of the year.

Sincerely,

Charles M. Stover
System Operations Supervisor

cc: Mr. Chuck Sumner, COE

911867.3

APPENDIX A

Stover, Charles M.

From: Stover, Charles M.

Sent: Tuesday, May 29, 2007 3:29 PM

To: Otto, Douglas C Jr SAM; Allen, Robert A SAM; memphis.vaughan.jr@sam.usace.army.mil; 'michael.h.thompson@sam.uscae.army.mil'

Cc: Atkins, Brian; Bowers, Willard L.; Akridge, R. M.; Allison, Eugene B., Jr.

Subject: Proposed Recuction of Alabama River Flow

Attachments: PROJECT 349 EXCERPT_001.pdf; Changes in Expenditures.pdf; Martin Rec Use Summary.doc

Doug and Bob,

Attached is the Martin License Article 12 dealing with navigation and 2 paragraphs from the Order issuing the license that reference the 1972 agreement.

Also attached are estimates of recreational impacts.

According to our records, here are the elevations of the water intakes @ Martin:

- Willow Point Golf Course - Current Withdrawal 0.85 MGD
  Elevation - (not yet determined)

- Alex City - Adams Water Treatment Facility - Current Withdrawal - 10.6 MGD
  Elevation of Intake - 470'

- Central Elmore water Authority - Current withdrawal - 6.7 MGD -
  Elevation of Intake 471' MD (centerline)

- Still Waters Resort - Current Withdrawal less than 1 MGD
  Elevation of Intake 484.7' MD

The storage projects on the Coosa and Tallapoosa are all below their drought contingency curve peak elevations. With inflows at record lows on the Coosa and Tallapoosa, the impact of maintaining a release of 4640 cfs to the Alabama River has fallen completely on the storage at Martin. Three scenarios, each with different discharge requirements, were forecasted to determine the scope of this impact.

#1 All projects reach winter level and flow terminates:

Weiss	558.00	7/25
Henry	506.50	7/19
Logan	459.70	7/18
Harris	784.89	7/19
Martin	479.97	7/11

#2 Flows begin to ramp by 10% a week beginning on June 16 after public comment period:

Martin	481.4	8/1

#3 Flow begin to ramp by 10% every 5 days beginning on June 1 after consultations:

Martin	483.4	8/1

APC advocates case #3 involving an immediate reduction in the provided navigation flow to the Alabama River. The navigation release would be reduced in 10% increments every five days beginning June 1st until a flow of 2784 cfs is achieved. The Martin elevation is forecasted to be at 483.4 by August 1. This case has the least devastating effects on the Tallapoosa and Coosa reservoirs.

The second scenario reviewed involves reducing the flows by 10% every seven days beginning on June 16th. Delaying a reduction in flow until June 16th will result in Martin arriving at 481.4 by August 1.

If the 4640 cfs release is continued until the Coosa and Tallapoosa projects reach winter pool levels, the discharge is expected to be reduced to inflows by July 25th. In maintaining the 4640 cfs release throughout the summer, Martin is projected to be 14 ft below the rule curve by early August.

Additionally we would ask that you reconsider your operations at Carters and Allatoona to provide releases from storage withdrawals of approximately 1000 cfs a day to supplement the record low flows downstream of those projects. If this drought continues unabated we are in danger of loosing all generating capability at Weiss, Henry and Logan Martin as water levels become too low to operate the turbines. At Weiss at 556.0 the intake canal impinges on the turbine capacity. At Henry and Logan Martin the limits for operation are 496 and 453 respectively. Without sufficient releases from Corps storage projects we could see these levels before the summer is out. The loss of this generation would severely impact the reliability of the electric system.

Please keep us informed as to the progress of these requests.

Charles Stover

APPENDIX
B

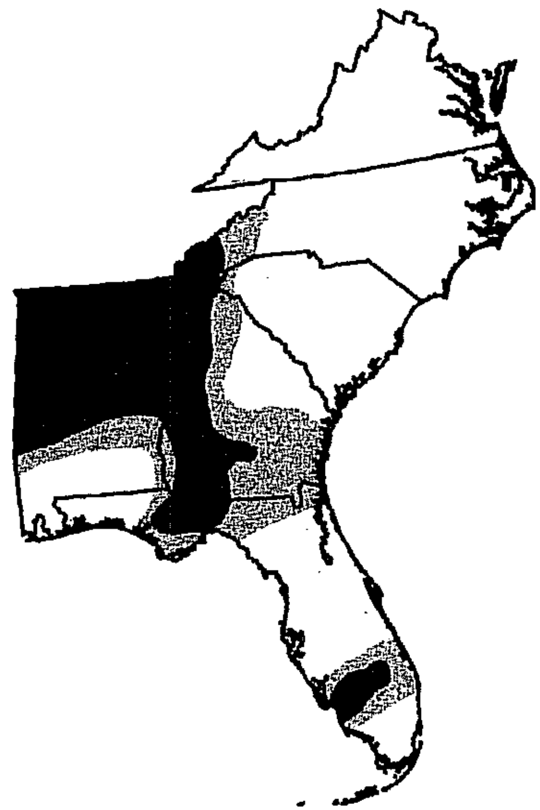
U.S. Drought Monitor

Southeast

June 5, 2007
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	11.2	88.8	68.1	39.9	24.0	3.9
Last Week (05/29/2007 map)	10.3	89.7	82.6	47.6	27.6	0.0
3 Months Ago (03/13/2007 map)	24.9	75.1	24.8	1.8	0.0	0.0
Start of Calendar Year (01/02/2007 map)	52.2	47.8	10.2	1.5	0.0	0.0
Start of Water Year (10/03/2006 map)	47.0	53.0	33.2	0.0	0.0	0.0
One Year Ago (06/06/2006 map)	34.6	65.4	31.3	3.7	0.0	0.0



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

USDA National Drought Mitigation Center

Released Thursday, June 7, 2007
Author: Scott Stephens, NOAA/NESDIS/NCDC

SUPPAR012215

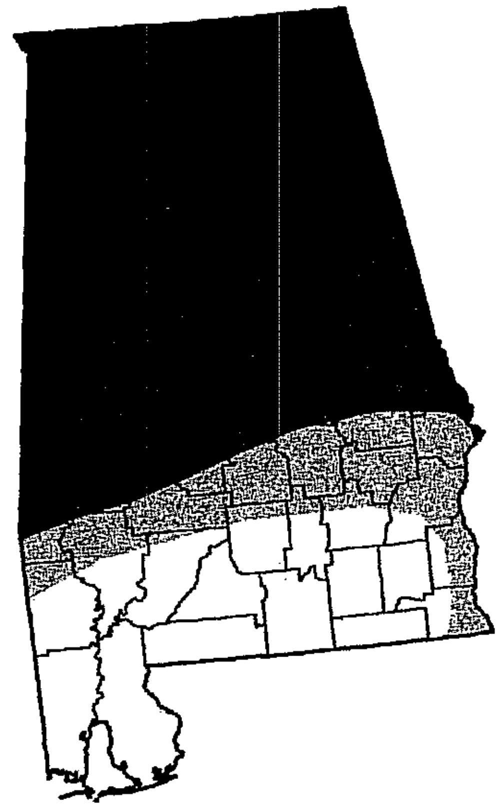
U.S. Drought Monitor

June 5, 2007
Valid 7 a.m. EST

Alabama

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.0	100.0	100.0	76.4	62.7	21.9
Last Week (05/29/2007 map)	0.0	100.0	100.0	69.1	60.1	0.0
3 Months Ago (03/13/2007 map)	5.8	94.2	60.7	7.0	0.0	0.0
Start of Calendar Year (01/02/2007 map)	51.9	48.1	0.0	0.0	0.0	0.0
Start of Water Year (10/03/2006 map)	0.0	100.0	73.3	0.0	0.0	0.0
One Year Ago (06/06/2006 map)	79.6	20.4	8.3	5.4	0.0	0.0



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http://drought.unl.edu/dm

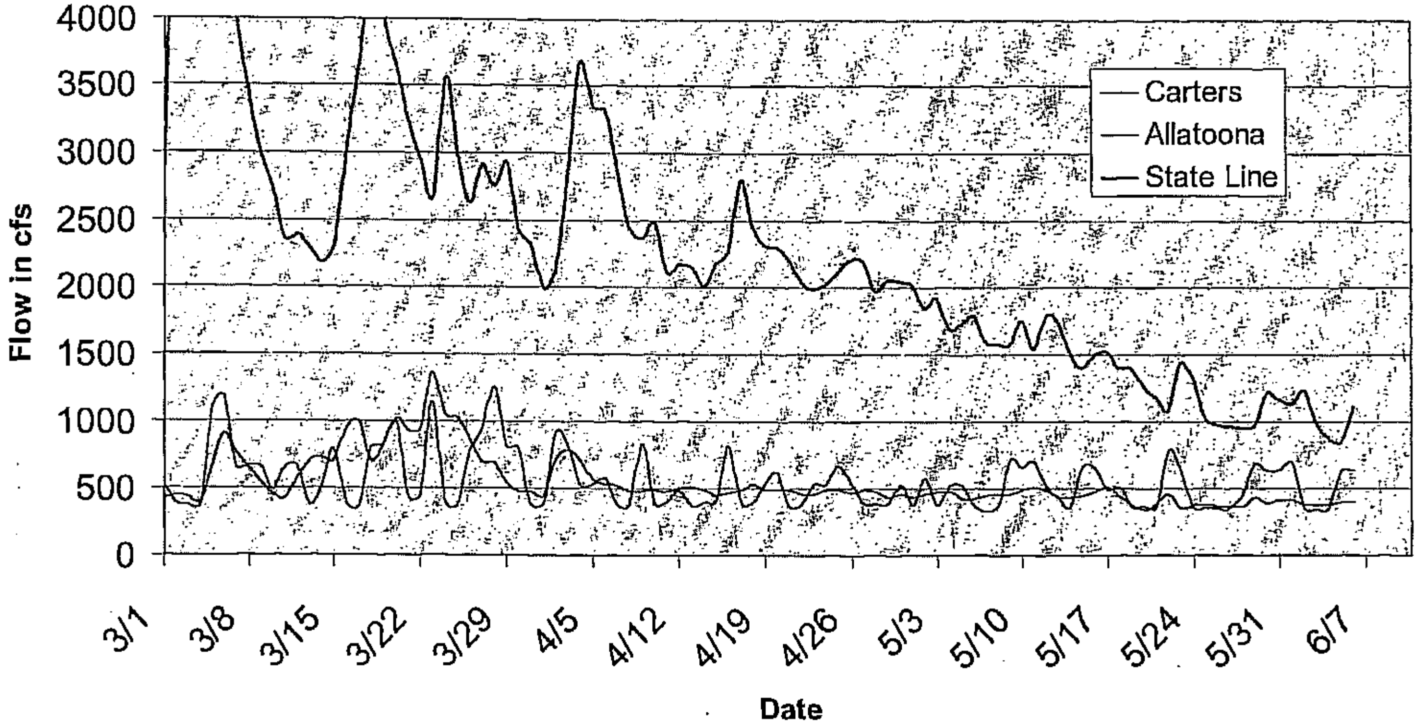
USDA National Drought Mitigation Center

Released Thursday, June 7, 2007

Author: Scott Stephens, NOAA/NESDIS/NCDC

APPENDIX C

2007 Flows from Corps Projects



Date	Coosawattee R. at Carters, GA	Etowah R. at Allatoona Dam, abv Cartersville, GA	Coosa R. near Rome, GA
3/1/2007	423	525	2900
3/2/2007	437	379	6420
3/3/2007	427	378	8220
3/4/2007	397	378	6310
3/5/2007	666	1110	4460
3/6/2007	902	1190	4160
3/7/2007	765	650	4000
3/8/2007	642	671	3390
3/9/2007	541	659	2980
3/10/2007	456	489	2730
3/11/2007	422	641	2360
3/12/2007	580	654	2390
3/13/2007	702	376	2290
3/14/2007	726	511	2180
3/15/2007	706	789	2300
3/16/2007	949	369	3080
3/17/2007	992	367	3700
3/18/2007	706	801	4460
3/19/2007	819	810	4020
3/20/2007	1020	992	3640
3/21/2007	921	425	3220
3/22/2007	937	439	2940
3/23/2007	1370	1140	2680
3/24/2007	1050	380	3570
3/25/2007	1030	378	2970
3/26/2007	869	772	2630
3/27/2007	698	923	2910
3/28/2007	684	1250	2760
3/29/2007	542	816	2930
3/30/2007	473	806	2430
3/31/2007	469	383	2330
4/1/2007	437	388	1990
4/2/2007	714	914	2150
4/3/2007	784	825	2870
4/4/2007	708	530	3680
4/5/2007	569	532	3340
4/6/2007	531	578	3320
4/7/2007	515	378	2880
4/8/2007	478	378	2450
4/9/2007	478	825	2370
4/10/2007	485	387	2490
4/11/2007	479	391	2110
4/12/2007	492	484	2170
4/13/2007	510	363	2150
4/14/2007	491	397	2010
4/15/2007	436	402	2180
4/16/2007	467	810	2260

Date	Coosawattee R. at Carters, GA	Etowah R. at Allatoona Dam, abv Cartersville, GA	Coosa R. near Rome, GA
4/17/2007	484	389	2800
4/18/2007	532	390	2450
4/19/2007	484	535	2320
4/20/2007	490	618	2310
4/21/2007	481	378	2220
4/22/2007	447	380	2040
4/23/2007	451	526	1990
4/24/2007	481	531	2020
4/25/2007	486	666	2110
4/26/2007	465	528	2200
4/27/2007	483	379	2190
4/28/2007	472	379	1980
4/29/2007	426	381	2060
4/30/2007	452	524	2040
5/1/2007	428	378	2010
5/2/2007	452	574	1850
5/3/2007	479	378	1920
5/4/2007	470	523	1690
5/5/2007	420	523	1730
5/6/2007	418	378	1800
5/7/2007	443	333	1610
5/8/2007	456	378	1580
5/9/2007	455	714	1580
5/10/2007	488	650	1750
5/11/2007	508	704	1550
5/12/2007	475	511	1800
5/13/2007	425	416	1740
5/14/2007	426	367	1510
5/15/2007	441	657	1400
5/16/2007	474	649	1500
5/17/2007	510	489	1520
5/18/2007	445	511	1400
5/19/2007	373	366	1400
5/20/2007	337	366	1250
5/21/2007	387	366	1170
5/22/2007	447	783	1090
5/23/2007	354	640	1430
5/24/2007	368	354	1310
5/25/2007	373	354	1020
5/26/2007	361	354	972
5/27/2007	357	354	955
5/28/2007	359	447	946
5/29/2007	434	681	972
5/30/2007	381	635	1210
5/31/2007	404	634	1160
6/1/2007	408	688	1130
6/2/2007	369	345	1230

Date	Coosawattee R. at Carters, GA	Etowah R. at Allatoona Dam, abv Cartersville, GA	Coosa R near Rome, GA
6/3/2007	368	344	979
6/4/2007	375	343	882
6/5/2007	394	629	848
6/6/2007	393	630	1110

APPENDIX D

Reliability Impacts On Transmission System Operation Due To Reduced Availability Of Alabama Power Company Hydro Generation

The reliable operation of Alabama Power Company's interconnected transmission system would be negatively impacted by reducing the availability of our Hydro Generation, particularly during our peak demand months this summer. Some of the effects on transmission system reliability caused by reduced hydro availability this summer would be, but are not limited to the following:

- The transmission system is planned, designed and constructed assuming that all but two elements of our bulk power system (transmission lines and generators) are available to serve our customers peak summer demand. Reduced availability of our Hydro generation when daily system loads are greater than 92% of our forecasted peak demand for that day will result in the potential for the following reliability problems:

    - Thermal overloads on transmission lines
    - Inability to remove equipment from service to perform emergency maintenance
    - Inability to redirect power flows during system outages
    - Inability to redirect power flows to accommodate unexpected generator outages or unusual generation dispatch patterns

- Potential curtailment of non-firm business on our bulk power system during peak load conditions

- Potential reduction in certain fossil generation due to the inability to provide cooling water from the reservoirs to fossil plants during peak load conditions on the bulk power system

As reduced availability of our Hydro generation becomes more severe, all of the reliability issues listed above become more probable. Ultimately, the only control mechanism left to prevent a wide area blackout is to curtail service to large numbers of our customers in order to solve these identified reliability problems and maintain the stability of our bulk power system.

R G Parsons

Ronald G. Parsons
Manager -
Transmission Interconnections and Operations

6-11-07
Date

APPENDIX
E

APC Hydro Operating Plan Summary

Record Drought Conditions 2007

(blue is 6/11 modeling - revised 6/11/07)

Assumes minimum release from upstream Corps projects and no reduction in navigation release.

Stage 1 — Dry Winter

January 1 – February 16

- Begin at normal winter levels
- Normal Operations

Stage 2 — Limit Tallapoosa to Thurlow Minimum

February 17 – March 8

- Begin Martin and Harris at winter levels
- Reduced Thurlow flow on February 27
- Filling all projects

Stage 3 — Filling While Meeting Navigation Flow from Coosa

March 8 - April 8

- Limit releases to navigation flow beginning March 8
- Filling all projects
- Further reduction in Thurlow Minimum Flow by pulsing
- Reduction of Jordan spring release

Stage 4 — Pull Coosa to Meet Navigation – Filling Tallapoosa

April 9 – May 18

- Begin Coosa at full – Tallapoosa 3-4 feet low
- Pull 1 foot from Lay and Mitchell

Stage 5 — Pull Martin to Meet Navigation – Pull Coosa for Jordan Minimum

May 19 - June 2

- Weiss and Logan Martin near or below drought curves

Stage 6 — Pull Martin to Meet Navigation – Pull Lower Coosa for Jordan 2250

June 2 – June 30

- Jordan to 2250 by June 5
- Notices to pull Lay, Mitchell and Jordan up to3 feet below normal

Stage 7 Pull Martin to Meet Navigation – Pass 3000 from Logan Martin
July 1- July 27

- Water to meet DO, Gaston temperature and Bowater
- Store 750 in Lay, Mitchell and Jordan

Stage 8 Thurlow to 300 – Coosa Meets Navigation - 3000 from L Martin
July 27 - August 28

- Tallapoosa meets minimum only and holds for water intakes
- Harris at 785 – Martin at 487.5 (Water supplies)
- Water to meet DO, Gaston temperature and Bowater

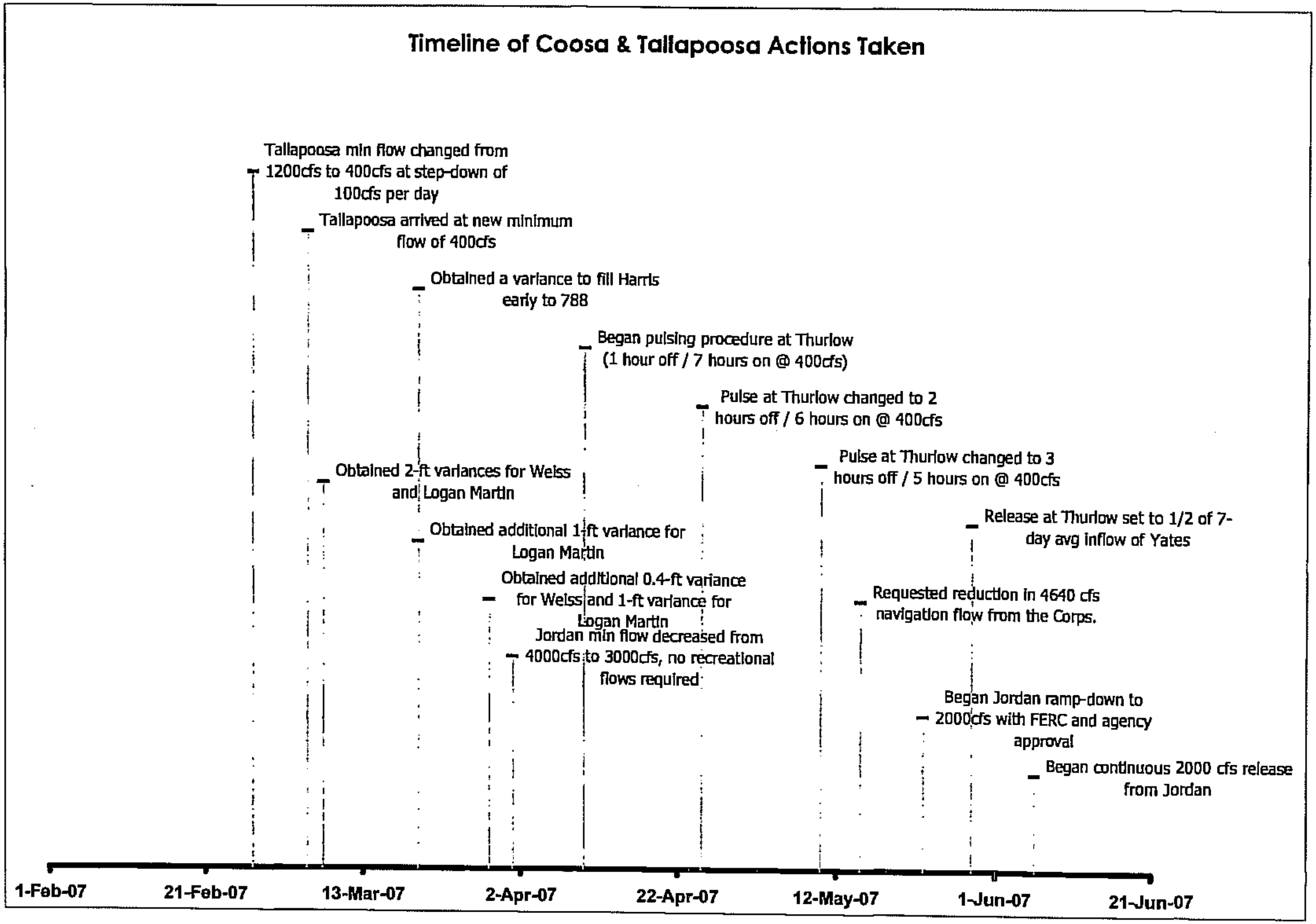
Stage 9 Lower Coosa Meets Jordan 2250
August 29 – August 31

- Upper Coosa at lower limits Weiss 555.5 – Henry 500 – Logan Martin 452.5
- Inflow by Logan Martin
- Pull lower Coosa to Limits
- 300 from Thurlow

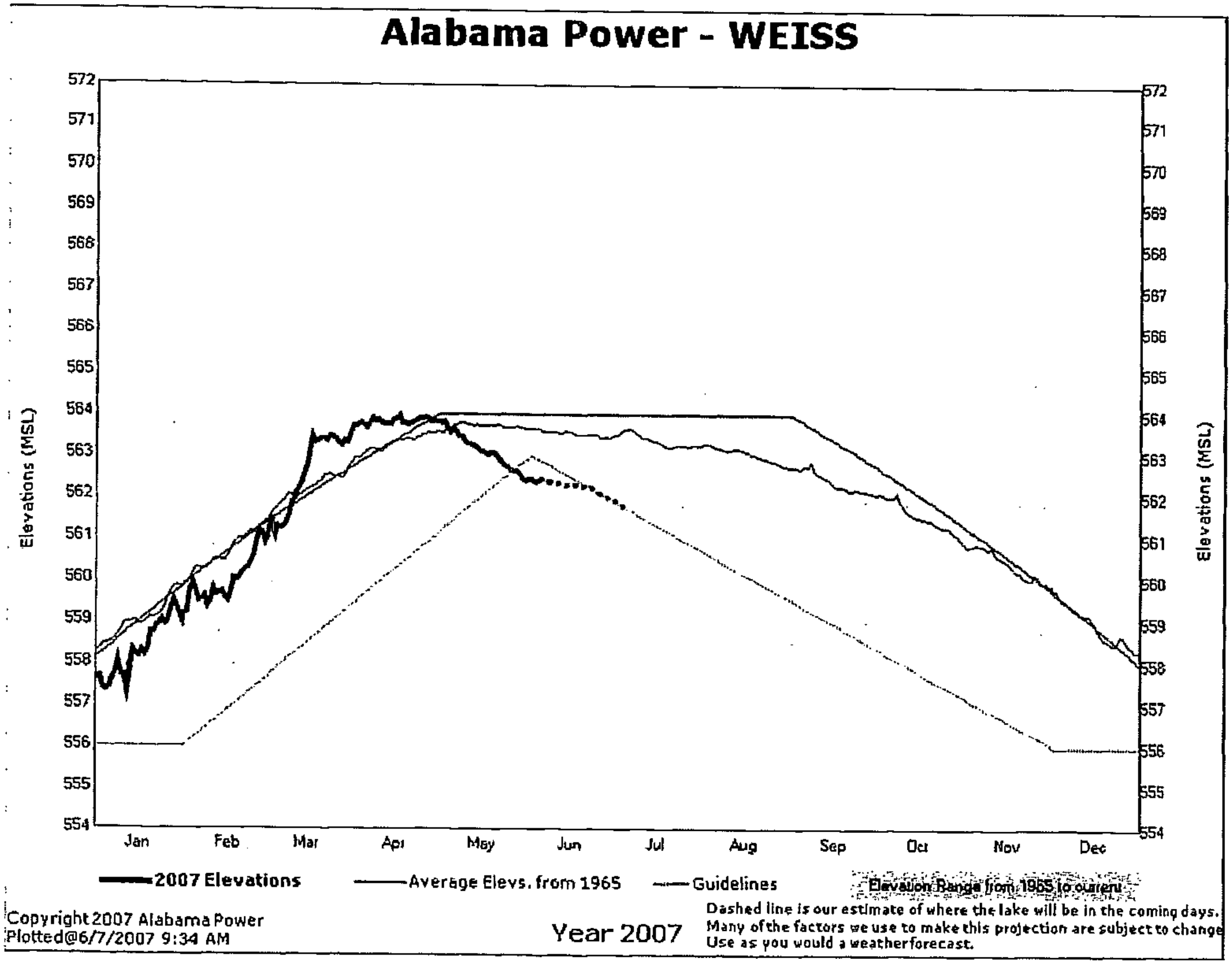
Stage 10 Coosa Storage Exhausted – Pass inflow
September 1

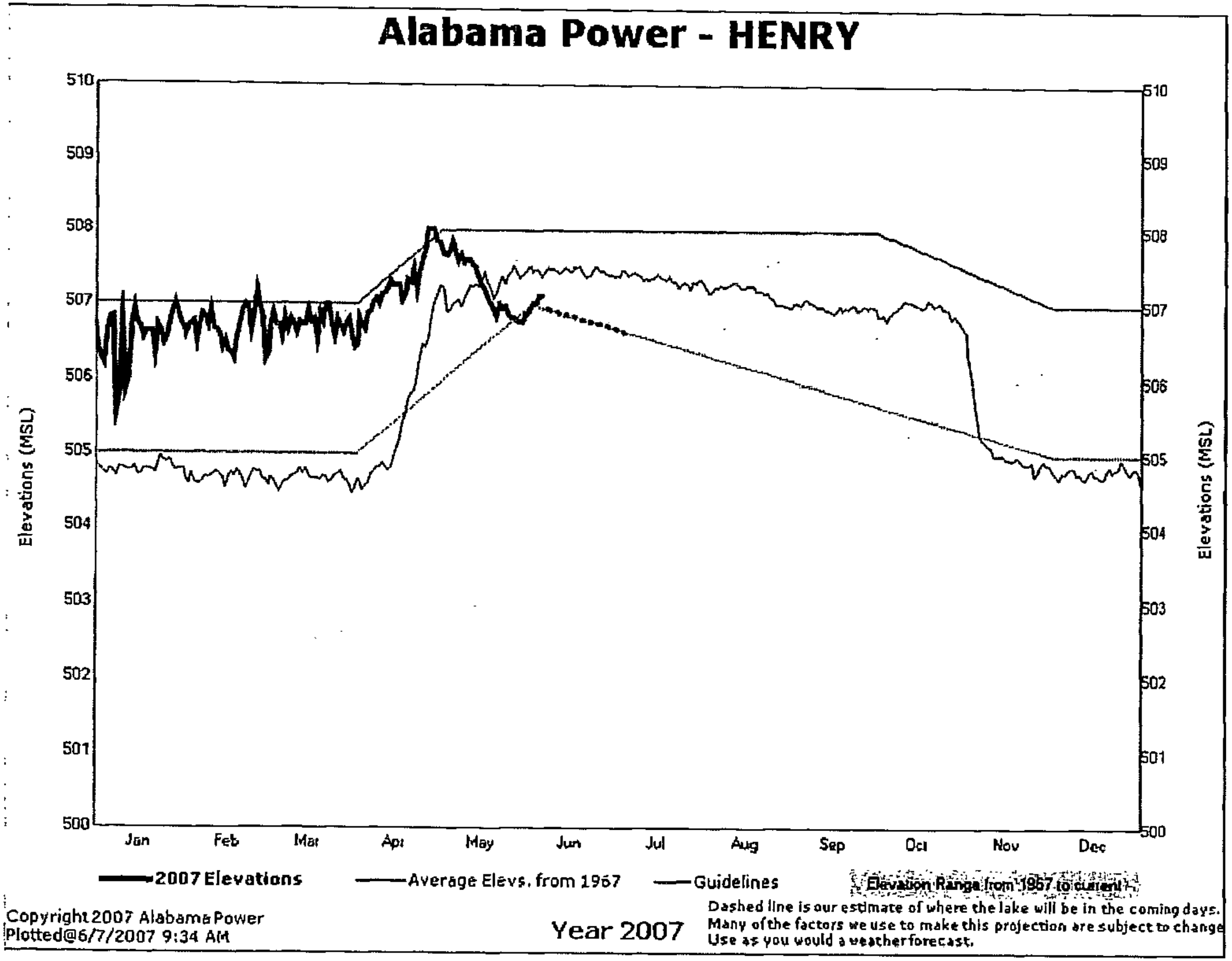
- Upper Coosa at lower limits Weiss 555.5 – Henry 500 – Logan Martin 452.5
- Inflow by Logan Martin
- Lower Coosa at lower limits Lay 389 – Mitchell 305 – Jordan 248
- 300 from Thurlow

Water supply limits in blue are increase by 1 foot. Hydro plant operational limits are in red.
Jordan – Bouldin are limited by both at the same elevation


Timeline of Coosa & Tallapoosa Actions Taken
Tallapoosa min flow changed from 1200cfs to 400cfs at step-down of 100cfs per day
Tallapoosa arrived at new minimum flow of 400cfs
Obtained a variance to fill Harris early to 788
Began pulsing procedure at Thurlow (1 hour off / 7 hours on @ 400cfs)
Pulse at Thurlow changed to 2 hours off / 6 hours on @ 400cfs
Obtained 2-ft variances for Weiss and Logan Martin
Pulse at Thurlow changed to 3 hours off / 5 hours on @ 400cfs
Release at Thurlow set to 1/2 of 7-day avg inflow of Yates
Obtained additional 1-ft variance for Logan Martin
Obtained additional 0.4-ft variance for Weiss and 1-ft variance for Logan Martin
Requested reduction in 4640 cfs navigation flow from the Corps.
Jordan min flow decreased from 4000cfs to 3000cfs, no recreational flows required
Began Jordan ramp-down to 2000cfs with FERC and agency approval
Began continuous 2000 cfs release from Jordan
1-Feb-07
21-Feb-07
13-Mar-07
2-Apr-07
22-Apr-07
12-May-07
1-Jun-07
21-Jun-07

APPENDIX F


Alabama Power - WEISS
Elevations (MSL)
572
571
570
569
568
567
566
565
564
563
562
561
560
559
558
557
556
555
554
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2007 Elevations
Average Elevs. from 1965
Guidelines
Elevation Range from 1965 to current
Copyright 2007 Alabama Power
Plotted@6/7/2007 9:34 AM
Year 2007
Dashed line is our estimate of where the lake will be in the coming days.
Many of the factors we use to make this projection are subject to change
Use as you would a weather forecast.


Alabama Power - HENRY
Elevations (MSL)
510
509
508
507
506
505
504
503
502
501
500
Jan
Feb
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May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2007 Elevations
Average Elevs. from 1967
Guidelines
Elevation Range from 1967 to current
Dashed line is our estimate of where the lake will be in the coming days.
Many of the factors we use to make this projection are subject to change
Use as you would a weather forecast.
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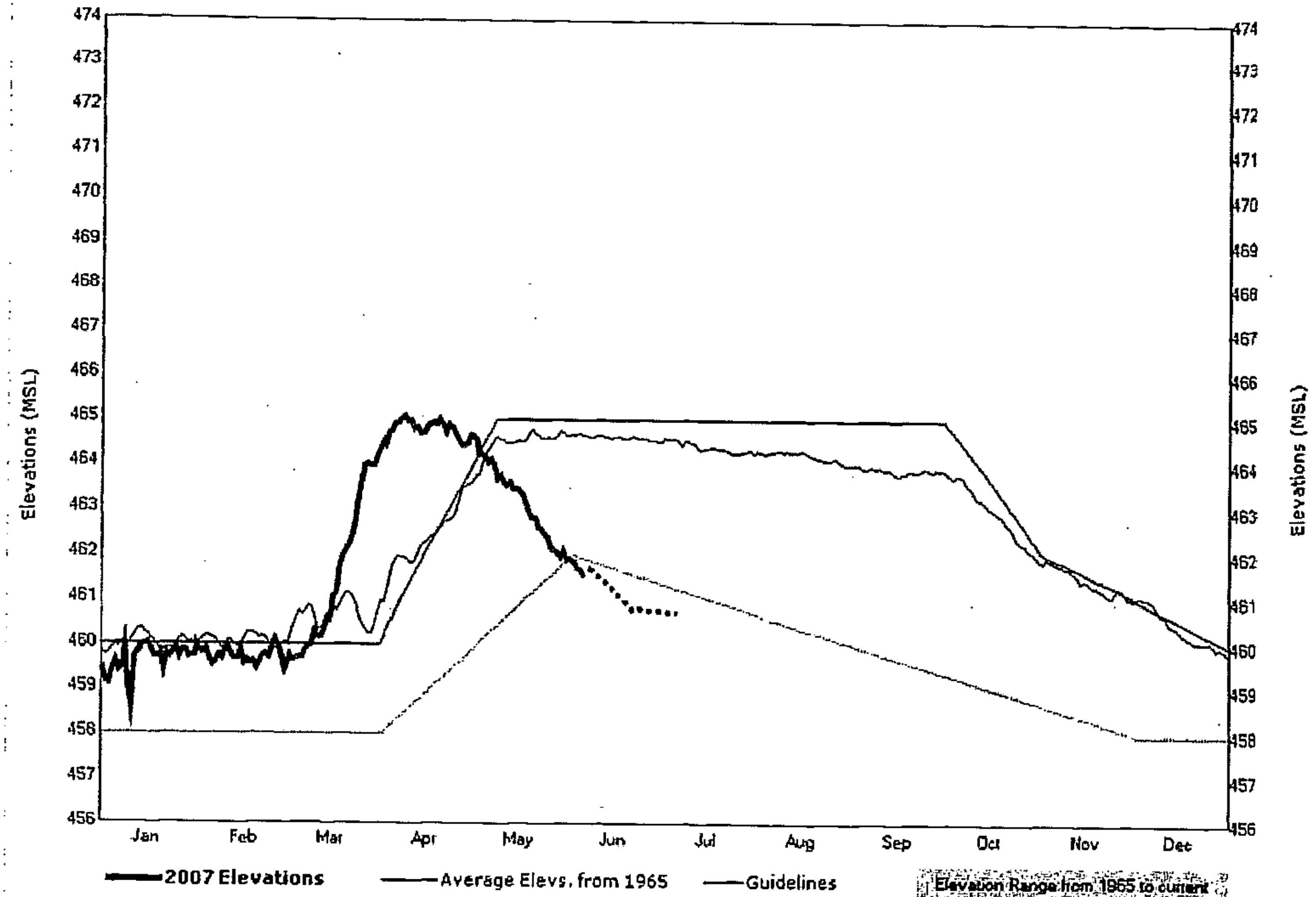
Year 2007

Alabama Power - LOGAN MARTIN



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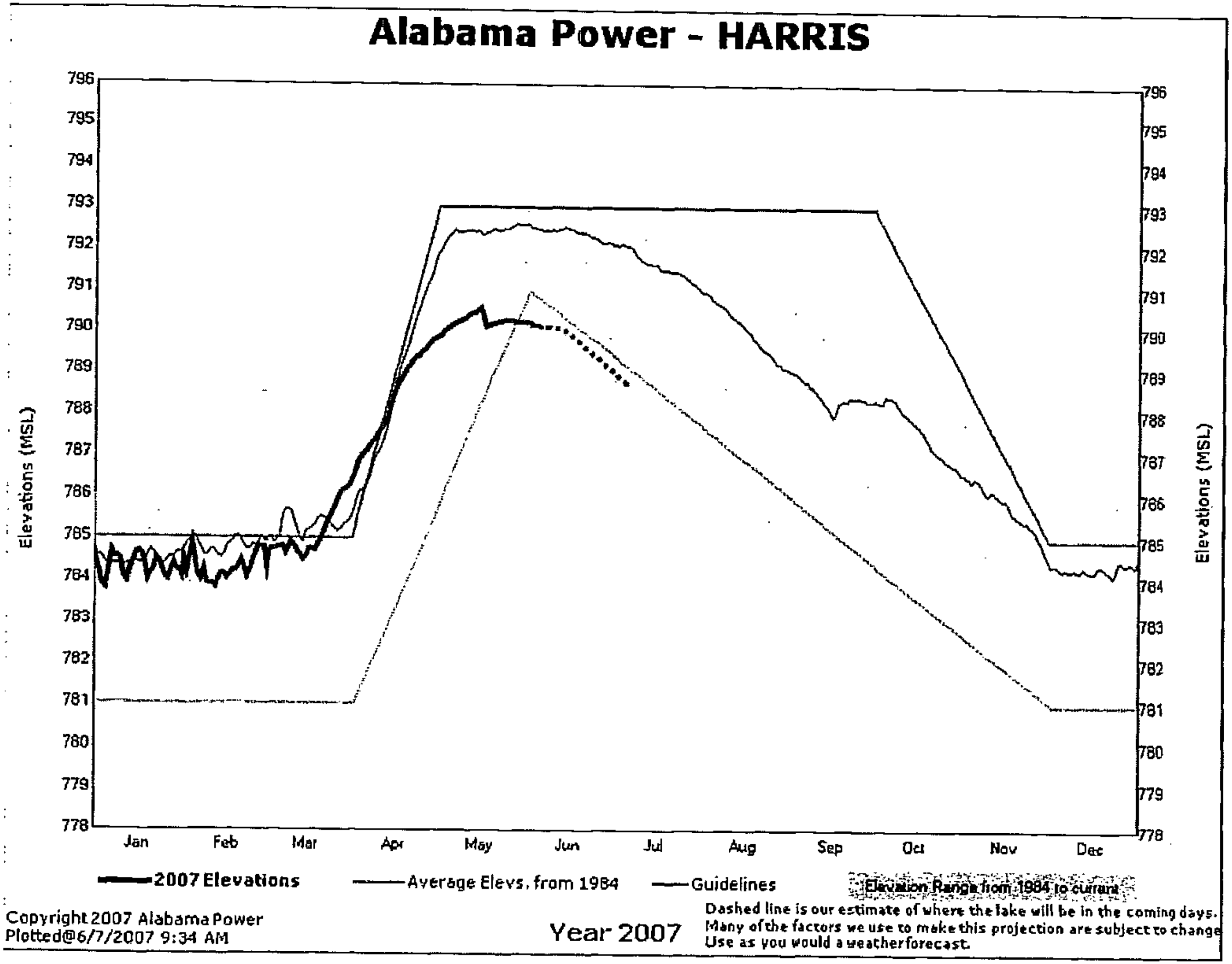
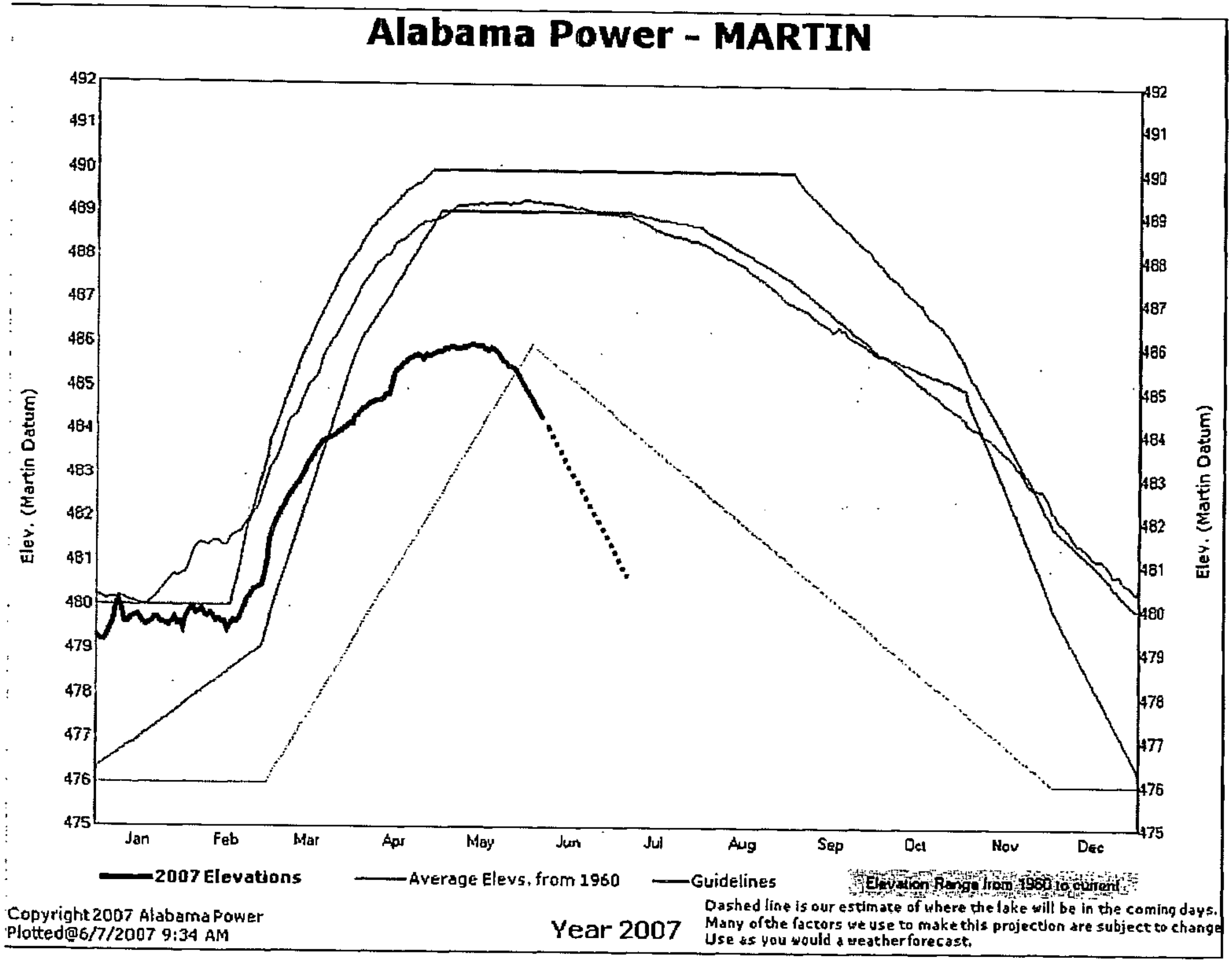
Year 2007

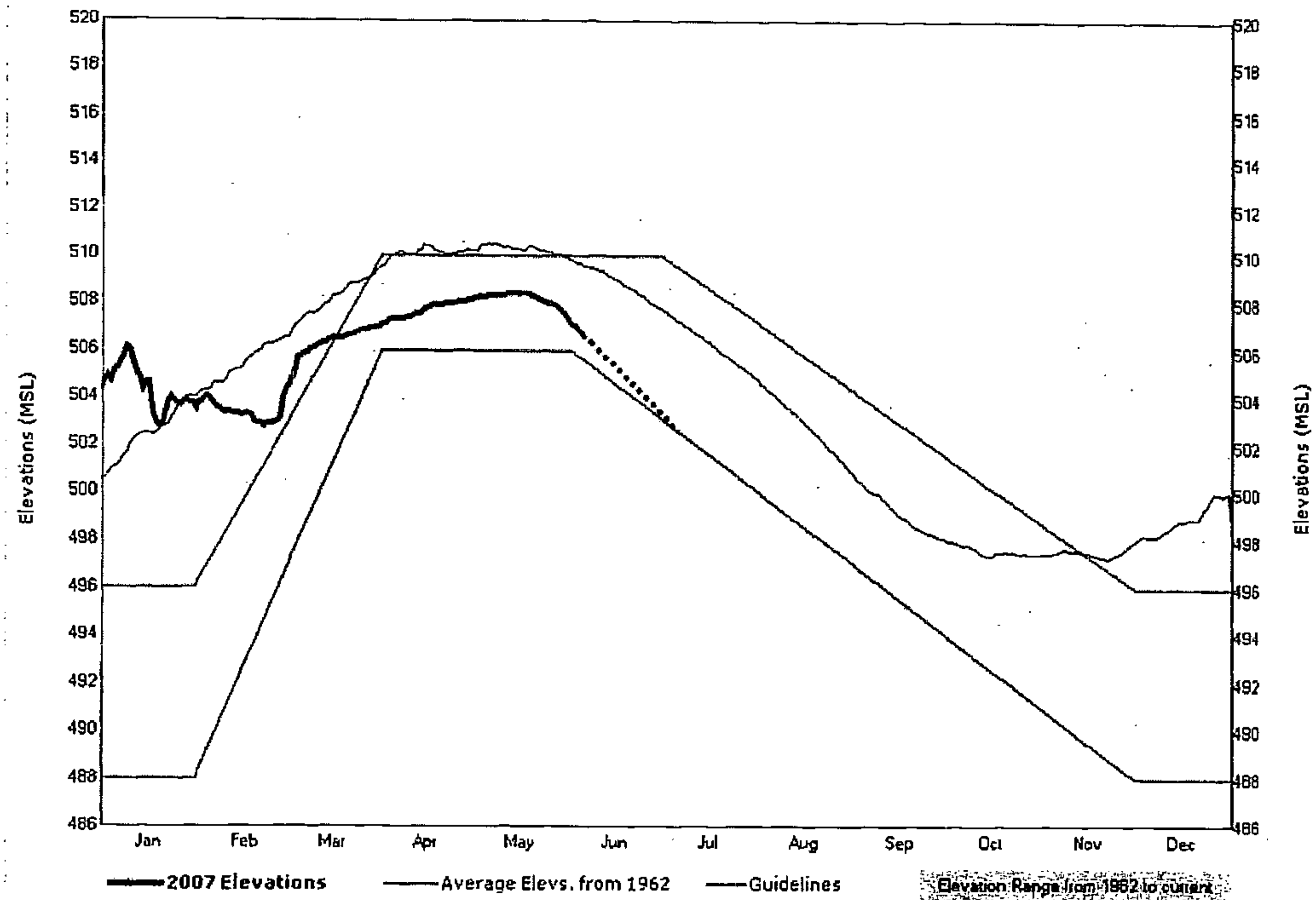
Dashed line is our estimate of where the lake will be in the coming days. Many of the factors we use to make this projection are subject to change. Use as you would a weather forecast.


Alabama Power - HARRIS
Elevations (MSL)
796
795
794
793
792
791
790
789
788
787
786
785
784
783
782
781
780
779
778
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2007 Elevations
Average Elevs. from 1984
Guidelines
Elevation Range from 1984 to current
Dashed line is our estimate of where the lake will be in the coming days.
Many of the factors we use to make this projection are subject to change
Use as you would a weatherforecast.
Copyright 2007 Alabama Power
Plotted@6/7/2007 9:34 AM
Year 2007



SUPPAR012234

Alabama Power - SMITH



Year 2007

Dashed line is our estimate of where the lake will be in the coming days.
Many of the factors we use to make this projection are subject to change
Use as you would a weather forecast.

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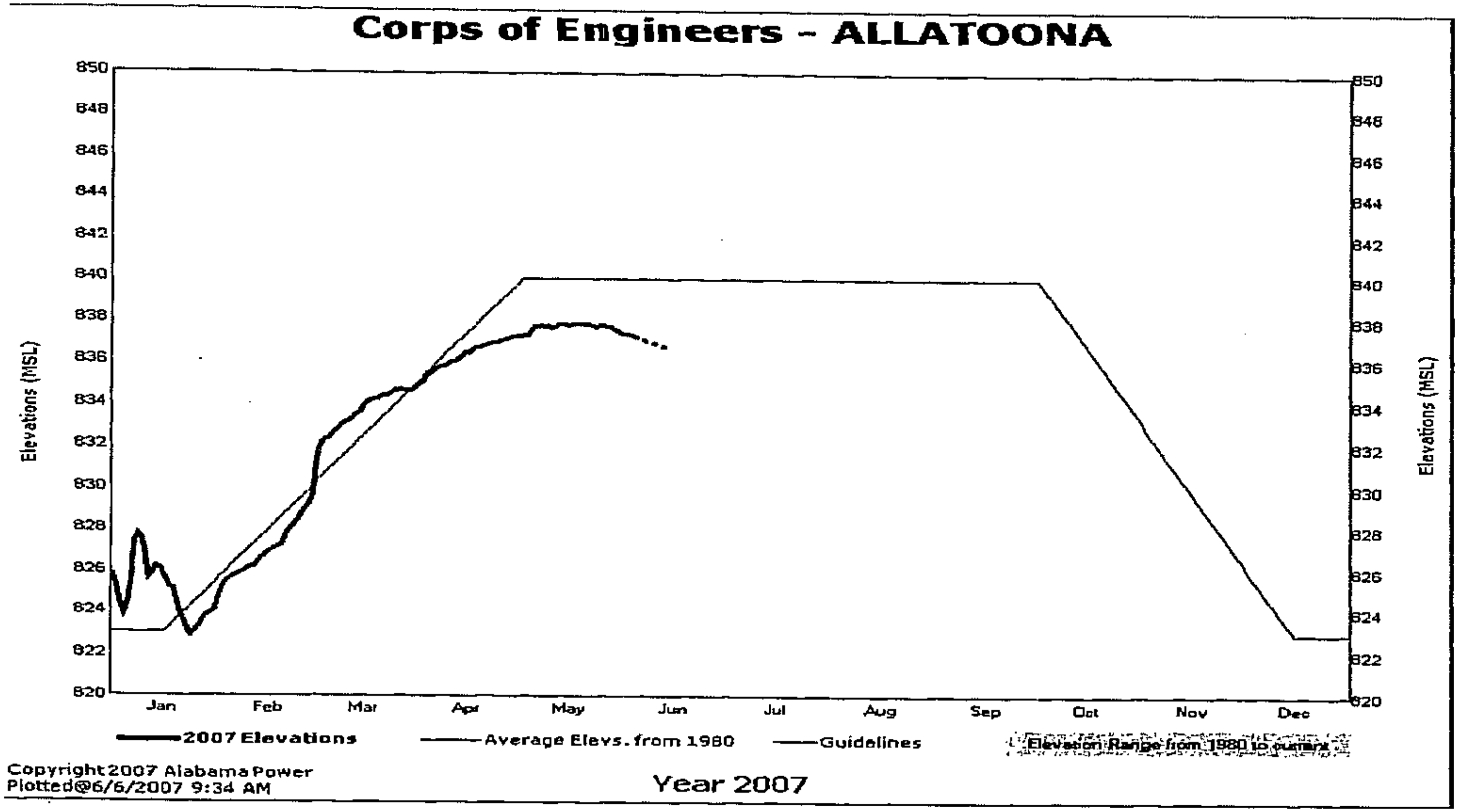
APPENDIX
G

Allatoona



Corps of Engineers - ALLATOONA
Elevations (MSL)
850
848
846
844
842
840
838
836
834
832
830
828
826
824
822
820
Jan
Feb
Mar
Apr
May
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Jul
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Sep
Oct
Nov
Dec
2007 Elevations
Average Elevs. from 1980
Guidelines
Elevation Range from 1980 to current
Copyright 2007 Alabama Power
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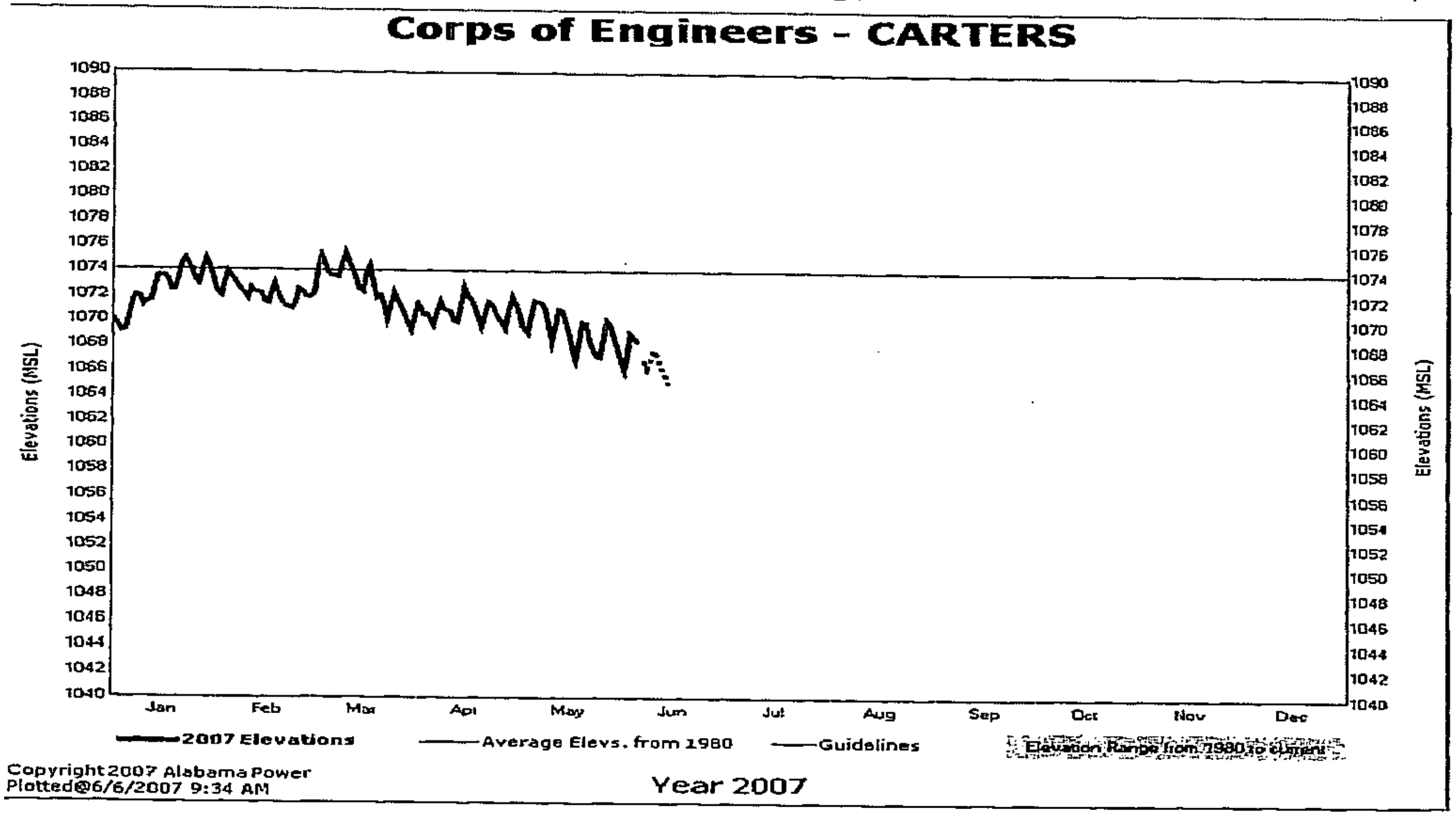
Year 2007

Carters


Corps of Engineers - CARTERS
Elevations (MSL)
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1086
1084
1082
1080
1078
1076
1074
1072
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1068
1066
1064
1062
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2007 Elevations
Average Elevs. from 1980
Guidelines
Elevation Range from 1980 to current
Copyright 2007 Alabama Power
Plotted@6/6/2007 9:34 AM
Year 2007

APPENDIX H

TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT

For NUTRIENT ENRICHMENT in

LAKE WEISS

(HUC 03150105)

Cherokee County, Coosa River Basin, Alabama

United States Environmental Protection Agency

Region 4 serving the southeast

Under the authority of Section 303(d) of the Clean Water Act, 33 U.S. Code §1251 et seq., as amended by the Water Quality Act of 1987 (PL 100-4), the U.S. Environmental Protection Agency is hereby establishing a TMDL for nutrients in Lake Weiss.

/s/
James D. Giattina, Director
Water Management Division

11/01/04
Date

↑ find this language in APCO letter

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Introduction

Section 303(d) of the Clean Water Act (CWA) as Amended by the Water Quality Act of 1987, Public Law 100-4, and the United States Environmental Protection Agency's (USEPA/EPA) Water Quality Planning and Management require each State to identify those waters within its boundaries not meeting water quality standards. Total maximum daily loads (TMDLs) for all pollutants violating or causing violation of applicable water quality standards are established for each identified water. Such loads are established at levels necessary to implement the applicable water quality standards with consideration given to seasonal variations and margins of safety. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (USEPA, 1991).

Problem Definition

Alabama's Section 303(d) lists identified forty miles of Lake Weiss in the Coosa River Basin between the Alabama-Georgia state line to the Lake Weiss powerhouse dampool as not supporting its designated use as a fishing water, with the pollutant of concern being nutrient enrichment. The Specific Lakes water quality criteria and antidegradation narrative criteria from the Code of Alabama rules and regulations (335-6-10.11 and 335-6-10.06 (c), 2001) applies. This listing decision was based on historical routine monitoring data that was collected in Lake Weiss and the data available in the Lake Weiss Phase 1 Diagnostic/Feasibility Study for water years 1991 and 1992 (Bayne 1993).

Target Identification

The chlorophyll-a target is based on Alabama Water Quality Criteria Applicable to Specific Lakes (335-6-10-.11 (2) (b) (1)) for Lake Weiss in the Coosa River Basin. chlorophyll-a: the mean of photic-zone composite of chlorophyll-a samples collected monthly April through October shall not exceed 20 ug/l, as measured at the deepest point, main river channel, power dam forebay; or 20 ug/l, as measured at the deepest point, main river channel, immediately upstream of the causeway (Alabama Highway 9) at Cedar Bluff. This water quality criterion was approved by USEPA in August 2002. The target level for the development of the nutrient enrichment TMDL in Lake Weiss are these specific lake criteria of 20 ug/l chlorophyll-a. The TMDL will be represented by the average nutrient loads that are allowable so that the reservoir achieves an average growing season (May-October) reservoir-wide chlorophyll-a concentration of 20 ug/l. This target will allow for sufficient productivity in the reservoir to maintain the fisheries, but on the other hand, reduce the risk of nuisance blooms of algae and reduce the hypolimnetic oxygen deficit, thereby improving fish habitat.

Background

Lake Weiss is a major impoundment with significant recreational fishing value to the public in both northeast Alabama and northwest Georgia. In addition, the reservoir serves as a source of water supply for the town of Cedar Bluff in Alabama. Alabama Power Company constructed the reservoir and manages hydroelectric operation with a generating capacity of 87,750 kilowatts.

Lake Weiss was formed when Alabama Power impounded the Coosa River in 1961 for the purpose of hydroelectric power generation. Other major tributaries to Lake Weiss include the Chattooga and Little Rivers. Lake Weiss drains approximately 13,657 square kilometers, most of which is located in northwest Georgia. The dam is a gravity concrete and earth-fill type with a maximum height of 26 meters. The reservoir is located in Cherokee County in northeastern Alabama near the Alabama-Georgia state line. (See Figure 1) The headwaters of the reservoir extend into Floyd County, Georgia. The Alabama towns of Centre, Leesburg, and Cedar Bluff are located in the immediate proximity of Lake Weiss, and the City of Rome, Georgia is located approximately 27 river miles upstream from the reservoir's headwaters. The reservoir lies in the Coosa Basin in the valley and ridge physiographic province of Northern Alabama. The reservoir at full pool encompasses over 12,000 hectares of surface area and a volume of almost 38,000 hectare-meters.

Full pool elevation is 172 meters above mean sea level and average depth of the reservoir is 3.1 meters. Drawdown of approximately 2 meters occurs from September until December, and the reservoir is allowed to reach full pool again by May. Average hydraulic retention time in the reservoir is approximately 18 days. Lake Weiss typically does not become thermally stratified due to its high flushing rate and relatively shallow average depth. Lake Weiss is chemically well mixed, but vertical gradients in dissolved oxygen are present during the spring, summer, and fall growing seasons.

Alabama Department of Environmental Management water-use classifications for Lake Weiss are:

- **Weiss Dam Powerhouse to Spring Creek** – Public Water Supply/Swimming/Fish and Wildlife
- **Spring Creek to state line** – Swimming/Fish and Wildlife

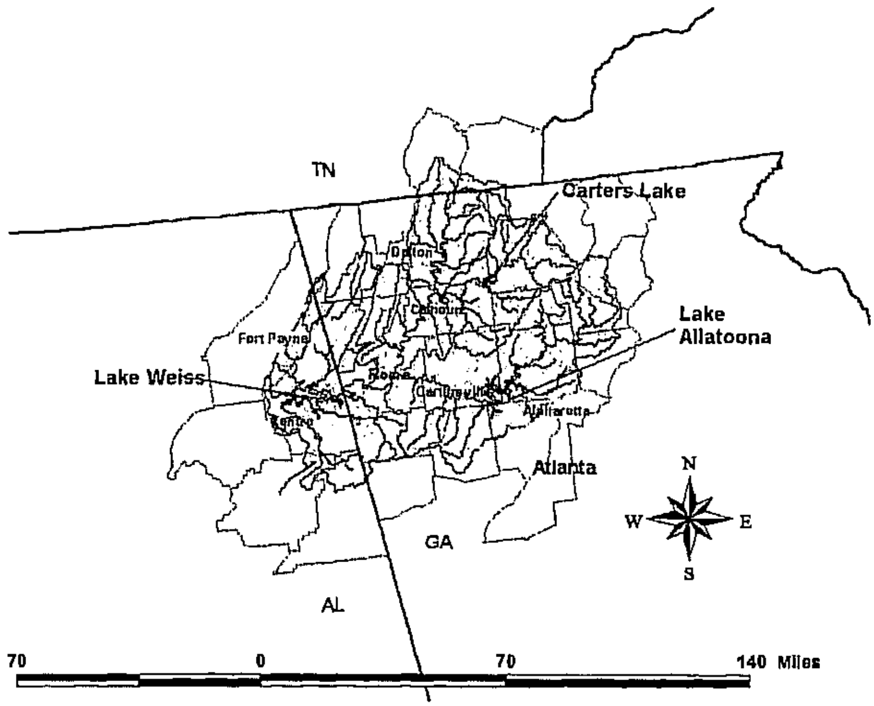

Figure 1: Lake Weiss Location Map

Available Monitoring Data

EPA Region 4 compiled the available monitoring data in the report "Summary of Water Quality Data and Information Developed Pursuant to Lake Weiss TMDL Study" (EPA, 2000). These data included reservoir vertical and longitudinal profiles for nutrients, algae, dissolved oxygen, and temperature. Other available data included meteorological, sediment oxygen demand, and algal growth potential test data and additional tributary monitoring conducted by Alabama Department of Environmental Quality (ADEM), Georgia Environmental Protection Division (GaEPD), and the United States Geologic Survey (USGS).

Figures 2, 3 and 4 indicate the levels of chlorophyll-a in Lake Weiss along with the flow and phosphorus concentrations and loadings to the lake. From 1991 to 2000 there has been a downward trend in the phosphorus loads to the lake.

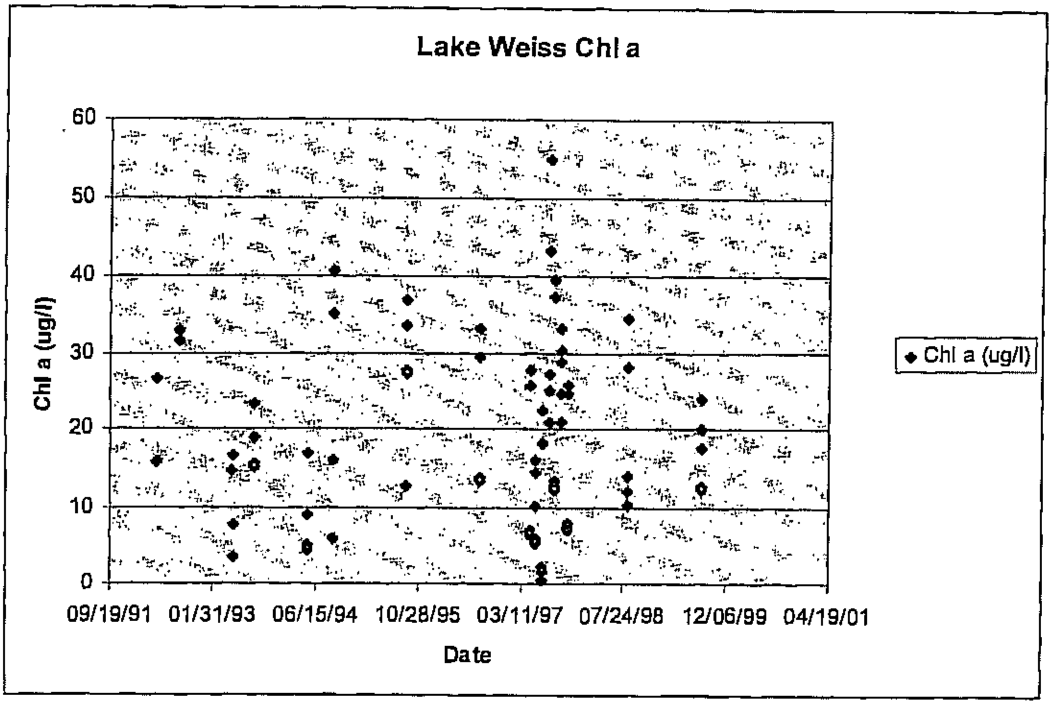

Figure 2: Lake Weiss Lake Wide Chl a Measurements

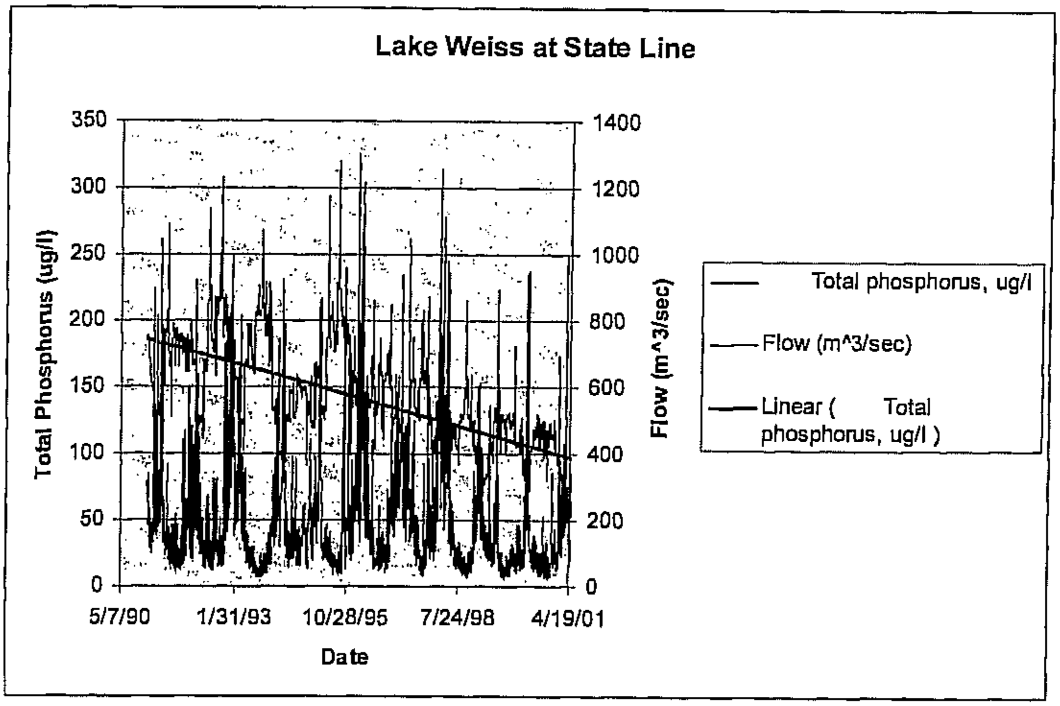

Figure 3: Lake Weiss Coosa River @ State Line Flow and TP

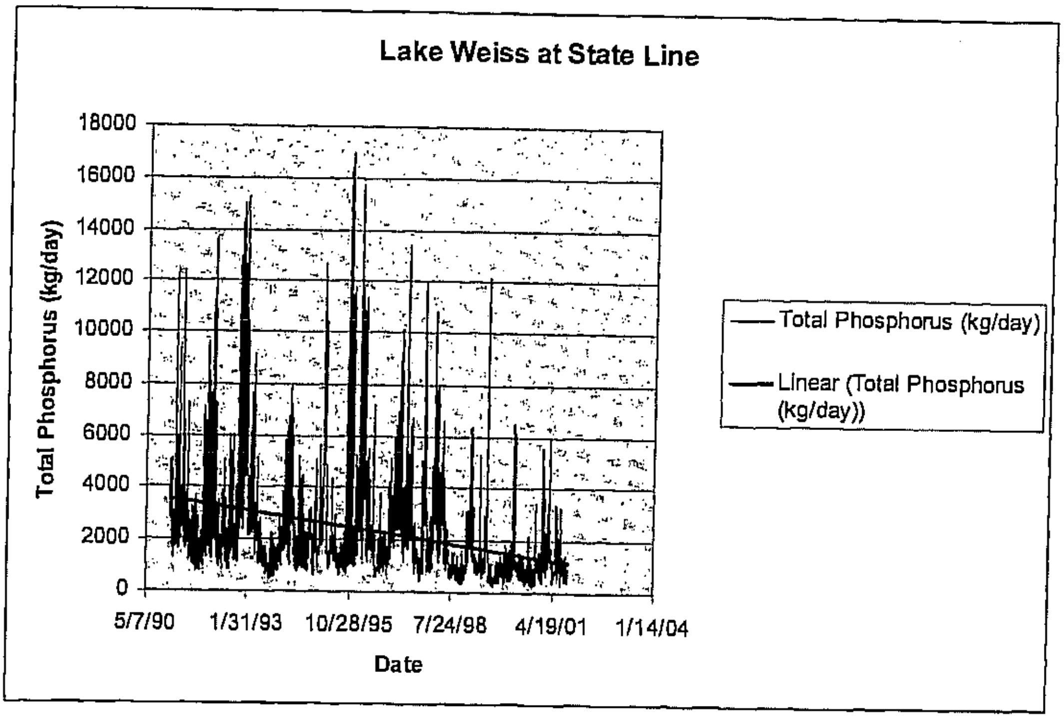

Figure 4: Lake Weiss Coosa River @ State Line TP Loading

Numeric Targets and Sources

Model Development

Weiss Lake was originally modeled with CE-QUAL-W2 by J. E. Edinger Associates, Inc. (JEEAI) in 1986 in support of thermal licensing issues at Plant Hammond on the Coosa River, just upstream of Weiss Lake (Edinger and Buchak, 1987a and 1987b). The Waterways Experiment Station made the definitive water quality application of CE-QUAL-W2 to Weiss Lake (Tilman, et.al., 1999). There have been several updates to the datasets since the WES modeling effort. The model was re-calibrated for 1991 by EPA Region 4 to enhance comparison of predicted and observed algae concentrations and phosphorus concentrations. Details on the model development are contained in the EPA Lake Weiss Calibration Report (EPA 2000). An additional 2002 model study "CE-QUAL-W2 Model Recalibration and Simulations in Support of TMDL Activities for Weiss Lake, Alabama" by J. E. Edinger Associates, Inc. was funded by EPA. The three objectives of the study were:

- Develop boundary conditions and set up Version 3 of CE-QUAL-W2 to run long term simulations for 10 years from 1991 to 2000,
- Calibrate the model using data for all 10 years, and
- Provide assistance in application of the model to (Total Maximum Daily Load) TMDL development.

The study was carried out in close technical collaboration with EPA.

The calendar year 1991 to 2000 model runs were evaluated and used to determine what nutrient loads can be received by the Lake and still meet the numeric target of a 20-ug/l chlorophyll-a value. This target is based on Alabama Water Quality Standards and the Lake Weiss Phase 1 Diagnostic/Feasibility Study for water years 1991 and 1992 (Bayne 1993) and evaluation of chlorophyll-a data collected by Alabama from 1991 through 2000. The target will allow for sufficient productivity in the reservoir to maintain the fisheries, but on the other hand, reduce the risk of nuisance blooms of algae and reduce the hypolimnetic oxygen deficit, thereby improving fish habitat.

Modeling Assumptions

The Lake Weiss modeling assumptions are reported in the 2002 model study "CE-QUAL-W2 Model Recalibration and Simulations in Support of TMDL Activities for Weiss Lake, Alabama" by J. E. Edinger Associates, Inc.

Total Maximum Daily Load (TMDL)

Critical Condition Determination

Due to Lake Weiss's relatively short retention time, the concept of phosphorus loading is not as important to productivity levels in the reservoir as phosphorus concentrations. High loads associated with high flows tend to flush more rapidly through the reservoir. Sensitivity analyses as well as review of historic data both suggest that Lake Weiss chlorophyll-a levels peak when reservoir hydraulic retention is relatively long. These conditions occur during average and low flow years when inflows and outflows are less and Alabama Power operates the reservoir to maintain pool volume. Nutrient concentrations in the reservoir are conducive to a very productive reservoir, and light limitations, as well as hydraulic retention are major controls regarding ultimate productivity in the reservoir.

Lake Weiss is a relatively shallow impoundment with a relatively high surface area to volume ratio. Wet years tend to introduce much higher nutrient loads to the reservoir, but in turn, these high loads are driven rapidly through the reservoir with springtime average hydraulic retention on the order of a week to ten days. Wet years also introduce higher suspended solids to the reservoir, further limiting productivity as the higher velocities help to maintain suspended solids concentrations.

Table 1 provides the measured 1991 to 2000 yearly Coosa River average flows, phosphorus concentrations and phosphorus loads, along with the model predicted Lake Weiss Growing Season Average Chlorphyll-a values. There is no single discernable critical condition or critical year to serve as the basis for the Lake Weiss phosphorus TMDL. Therefore, the average growing season Chlorophyll-a for the 10 year period from 1991 through 2000 was used develop the TMDL because it includes low, average and high flow periods which experience algal bloom events. Figures 5 and 6 provide a graphical display of flow and phosphorus load distribution.

Table 1: Years 1991 to 2000 Existing Conditions

Year	Flow m^3/sec	TP ug/l	TP kg/d	Reservoir Wide Growing Season Average Chla (ug/l)
1991	353	175	5289	28
1992	453	174	6723	21
1993	365	168	5292	16
1994	144	144	1804	21
1995	166	142	2090	26
1996	135	146	1664	23
1997	223	120	2308	23
1998	238	107	2205	22
1999	150	103	1321	28
2000	90	103	799	27
10 Year Average	232	138	2949	23
High Flow Year Average	390	172	5768	22
Medium Flow Year Average	184	123	1946	24
Low Flow Year Average	113	124	1232	25

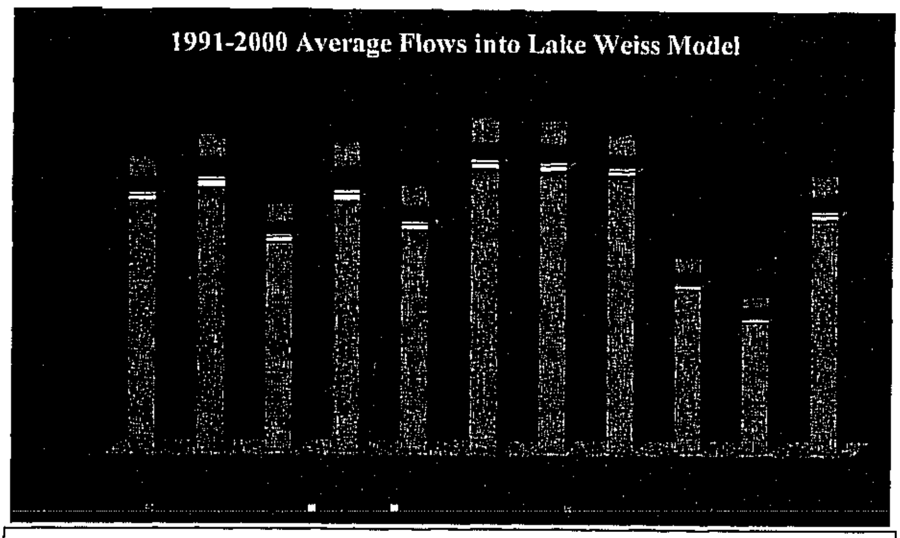

Figure 5: Average Annual Flows into Lake Weiss Model

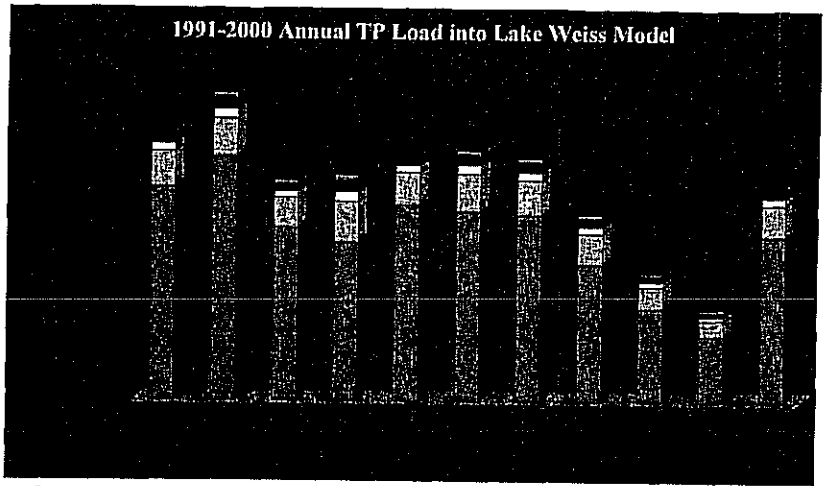

Figure 6: Total Phosphorus Annual Loads into Lake Weiss

Seasonal Variation and Margin of Safety

Seasonal variation and margin of safety were taken in to account by examining and evaluating the lake data for the years 1991 to 2000, a ten year timeframe, which contained low, average and high flow periods. Because of these data, the water quality model was able to simulate the complex interactions of flow rates, phosphorus loads and concentrations, and light penetration to algae productivity. The ten years of data indicated that Lake Weiss algal productivity is better correlated with annual average phosphorus concentration than the short-term mass loading of phosphorus into the Lake.

TMDL Determination

The objective of the Lake Weiss TMDL is to meet the 20 ug/l Chla targets at the two defined monitoring points. The annual seasonal averaged Chla at these monitoring points can be represented by the modeled lake wide growing season average Chla of 20 ug/l chlorophyll-a, based on the 1991 through 2000 historic flow and meteorological conditions. The water quality modeling indicates that algae productivity in Lake Weiss is dependent on the annual average phosphorus concentration observed in the Lake and in the retention time of the Lake. The model indicates that a ten year 70 μg/l phosphorus annual average concentration will effectively control spring and summer algal blooms, while ensuring that there is sufficient nutrients in the Lake to maintain the desired fishery. This annual average phosphorus concentration in conjunction with the annual measured flows can be used to calculate the acceptable annual average phosphorus load for the Lake. A ten year average phosphorus load of 1475 kg/day or an annual average load of 540,000 kg/year is necessary to meet the growing season average 20 μg/l chlorophyll-a target conditions during this ten year period of record. Since this period of record includes severe drought conditions, the use of a multi-year averaging period is considered protective for all but the most extreme conditions. Model simulations were run to determine the impacts of reducing the phosphorus annual average load necessary to meet the chlorophyll-a criterion under the most extreme observed conditions. Such stringent phosphorus load reductions would result in excessive reductions in algal productivity in average flow years, sufficient to jeopardize the Lake Weiss fishery.

The sources of phosphorus in Lake Weiss originate in two states, Alabama and Georgia. This TMDL allocates an aggregate allowable pollutant load, which includes both the point and nonpoint source contributions, to Georgia sources from the Coosa River and Chattooga River at the state line. Therefore, the TMDL for Lake Weiss allocates annual average phosphorus loads for Alabama's nonpoint sources and provides a gross allocation for all phosphorus loads from Georgia. Initial allocations of the TMDL of 540,000 kg/yr phosphorus equal 100,000 kg/yr Load Allocation in Alabama plus 440,000 kg/yr Aggregate Load allocation from Georgia at the state line, see Figure 6. These allocations are based upon the relative existing load contributions from the two states over the 1991-2000 ten-year period of record. These load allocations will be revisited and revised based on the addition monitoring and modeling activities that are occurring in the Coosa Basin.

The past ten years of phosphorus loading data indicate a downward trend as indicated in Figures 3 and 4. However, it is apparent that that additional load reduction from what occurred during the 1991 to 2000 time period are needed to fully achieve the water quality criterion of 20 ug/l chlorophyll-a in Lake Weiss.

Allocation of Responsibility and Recommendations

EPA, ADEM, and Georgia EPD are planning to integrate three TMDL efforts in the Coosa River Basin. The Georgia EPD in cooperation with EPA is conducting a watershed and river modeling project that will be used to modify and link the dissolved oxygen TMDL for the upstream segment of the Coosa River with a revised EPA model for Lake Weiss. This revised model will be compatible with the WASP/EFDC model developed by ADEM for the lower Coosa River Basin reservoirs' TMDLs. Linking all three models in a compatible format will facilitate the development of load allocation scenarios necessary to achieve the water quality standards and ensure all portions of the Coosa River will be protected.

The 2003 ADEM nutrient TMDLs required a 30 percent reduction in total phosphorus from Lake Weiss to meet the water quality standards in the downstream reservoirs. This 30 percent reduction in total phosphorus is consistent with the Lake Weiss TMDL approach of targeting a 70 ppb total phosphorus annual average concentration to ensure the growing season chlorophyll-a average concentrations achieve the 20 ppb water quality criterion. (Current state-line average total phosphorus concentration is 100 ppb, so a 30 percent reduction would achieve the 70 ppb target value.) The three parties are cooperating on developing a monitoring and modeling effort to further refine all three TMDLs.

REFERENCES

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APPENDIX
I

Water Quality Section Insert for Letter of Comment in response to COE Public Notice No. FP07-AC01-16

Alabama Power Company recommends additional combined daily releases from storage at Allatoona Lake and Carters Lake in order to minimize adverse water quality impacts to Weiss Lake. On November 1, 2004, the United States Environmental Protection Agency (USEPA) established a Total Maximum Daily Load (TMDL) for nutrients in Lake Weiss. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and nonpoint source and restore and maintain the quality of their water resources (USEPA, 1991).

The Weiss TMDL for nutrients was based on water quality modeling of Weiss Lake using the CE-QUAL-WE model. The hydrologic period of record used in the model was from calendar year 1991 to 2000. The model runs were evaluated and used to determine what nutrient loads can be received by the Lake and still meet the numeric target of a 20 microgram per liter chlorophyll-a value. Model sensitivity analysis as well as review of historic data both suggests that Lake Weiss chlorophyll-a levels peak when reservoir hydraulic retention is relatively long. Nutrient concentrations in the reservoir are conducive to a very productive reservoir, and light limitations, as well as hydraulic retention are major controls regarding ultimate productivity in the reservoir [(1)]. The water quality modeling also indicated that algae productivity in Lake Weiss is dependent on the annual average phosphorus concentration observed in the Lake and in the retention time of the Lake. The modeling results for high, medium, and low flow years contained in the TMDL are as follows:

Table 1. Years 1991 to 2000 Existing Conditions

	Flow (cfs)	**Total Phosphorus** (Micrograms/liter)	**Total Phosphorus** (Micrograms/liter)	**Reservoir Wide Growing Season** Average Chla (Micrograms/liter)
High Flow Year Average	13,770.9 (390 m^3/sec)	172	5768	22
Medium Flow Year Average	6497 (184 m^3/sec)	123	1946	24
Low Flow Year Average	3990 (113 m^3/sec)	124	1232	25

As can be seen from these results and the modeling simulations, the water quality conditions deteriorate as inflows decrease and Lake Retention times increase. For comparison purposes Table 2 compares current inflows measured at Weiss Dam into

Lake Weiss and reservoir retention times year to date (January 1 through May 31) with the inflows and retention times associated with the period of record (January 1 through May 31) used in the TMDL modeling.

Table 2. Comparison of Years 1991 – 2000 to 2007

Flow Year	Flow (cfs)	Retention Time (days)
1991	13734	9
1992	10779	12
1993	14720	8
1994	14317	9
1995	11069	12
1996	17040	8
1997	15453	8
1998	19401	7
1999	9610	13
2000	7236	18
2007	4324	31

As indicated from the information in Table 2, the retention time of Weiss Lake so far this year is approximately twice as long as the worst case conditions used in the TMDL modeling. This high retention time will likely result in very high algal growth and deterioration of water quality in the reservoir unless inflows are increased. Moreover, this deterioration will likely be exacerbated this year because nutrients (e.g. Phosphorus) entering the reservoir during the spring (March – May) is normally moved through the reservoir rather quickly as shown in Table 3. However, this year instead of moving through the reservoir in 1-2 weeks, the retention time increased almost three fold to 46 days.

Table 2. Comparison of spring (March-May) Years 1991 – 2000 to 2007

Flow Year	Retention Time (days)
1991	9
1992	15
1993	11
1994	9
1995	16
1996	10
1997	9
1998	8
1999	20
2000	16
2007	46

This coupled with the fact that water quality monitoring by Alabama Power Company in Weiss Lake on May 30, 2007 indicated average Total Phosphorus concentrations in the

Coosa River at the state line of 133 micrograms per liter which are considerably above the trend of average total phosphorus concentrations at the state line during low flow periods used in the TMDL modeling indicates without increased inflows in Weiss Lake extremely high eutrophication is likely in Weiss Lake this year which may lead to significant fish kills. This conclusion is also supported by the elevated chlorophyll-a concentration of samples collected at the state line on May 30, 2007 which averaged 33.87 mg/m^3 and is significantly higher than the TMDL target lake wide long term average chlorophyll-a concentration of 20 mg/m^3.

Footnote:
1. Total Maximum Daily Load (TMDL) Development For Nutrient Enrichment in Lake Weiss (HUC03150105) Cherokee County, Coosa River Basin, Alabama, November 1, 2004.

(1)

1991 Using Avg Flow & Elev	
Average Flow	9030
Average Elevation	562
Volume	125478
Retention Time	
	14 days

1992 Using Avg Flow & Elev	
Average Flow	10058
Average Elevation	562.09
Volume	127347
Retention Time	
	13 days

1993 Using Avg Flow & Elev	
Average Flow	8009
Average Elevation	561.90
Volume	124815
Retention Time	
	16 days

1994 Using Avg Flow & Elev	
Average Flow	10173
Average Elevation	562.01
Volume	126277
Retention Time	
	12 days

1995 Using Avg Flow & Elev	
Average Flow	8728
Average Elevation	562.00
Volume	126143
Retention Time	
	14 days

1996 Using Avg Flow & Elev	
Average Flow	10325
Average Elevation	562.35
Volume	130864
Retention Time	
	13 days

1997 Using Avg Flow & Elev	
Average Flow	10609
Average Elevation	561.88
Volume	124550
Retention Time	
	12 days

1998 Using Avg Flow & Elev	
Average Flow	10379
Average Elevation	561.94
Volume	125345
Retention Time	
	12 days

1999 Using Avg Flow & Elev	
Average Flow	6288
Average Elevation	561.54
Volume	120105
Retention Time	
	19 days

2000 Using Avg Flow & Elev	
Average Flow	4848
Average Elevation	561.20
Volume	115762
Retention Time	
	25 days

3

1991 Using Avg Flow & Elev	
Average Flow	14788
Average Elevation	563.02
Volume	140206
Retention Time	9 days

1992 Using Avg Flow & Elev	
Average Flow	9257
Average Elevation	563.10
Volume	141348
Retention Time	15 days

1993 Using Avg Flow & Elev	
Average Flow	12358
Average Elevation	562.72
Volume	135973
Retention Time	11 days

1994 Using Avg Flow & Elev	
Average Flow	15329
Average Elevation	563.13
Volume	141778
Retention Time	9 days

1995 Using Avg Flow & Elev	
Average Flow	9017
Average Elevation	563.01
Volume	140063
Retention Time	16 days

1996 Using Avg Flow & Elev	
Average Flow	14561
Average Elevation	563.67
Volume	149657
Retention Time	10 days

1997 Using Avg Flow & Elev	
Average Flow	15722
Average Elevation	563.50
Volume	147148
Retention Time	9 days

1998 Using Avg Flow & Elev	
Average Flow	17831
Average Elevation	563.17
Volume	142353
Retention Time	8 days

1999 Using Avg Flow & Elev	
Average Flow	6957
Average Elevation	563.05
Volume	140633
Retention Time	20 days

2000 Using Avg Flow & Elev	
Average Flow	8805
Average Elevation	563.13
Volume	141778
Retention Time	16 days

2007 Using Avg Flow & Elev	
Average Flow	3062
Average Elevation	563.13
Volume	141778
Retention Time	46 days

Mif

(2)

(pink)

1991 Using Avg Flow & Elev	
Average Flow	13275
Average Elevation	561.67
Volume	121793
Retention Time	
	9 days

1992 Using Avg Flow & Elev	
Average Flow	10299
Average Elevation	561.62
Volume	121142
Retention Time	
	12 days

1993 Using Avg Flow & Elev	
Average Flow	14599
Average Elevation	561.83
Volume	123890
Retention Time	
	8 days

1994 Using Avg Flow & Elev	
Average Flow	13922
Average Elevation	561.87
Volume	124418
Retention Time	
	9 days

1995 Using Avg Flow & Elev	
Average Flow	10533
Average Elevation	561.76
Volume	122970
Retention Time	
	12 days

1996 Using Avg Flow & Elev	
Average Flow	16602
Average Elevation	562.74
Volume	136252
Retention Time	
	8 days

1997 Using Avg Flow & Elev	
Average Flow	14905
Average Elevation	561.87
Volume	124418
Retention Time	
	8 days

1998 Using Avg Flow & Elev	
Average Flow	18938
Average Elevation	562.05
Volume	126811
Retention Time	
	7 days

1999 Using Avg Flow & Elev	
Average Flow	9228
Average Elevation	561.63
Volume	121272
Retention Time	
	13 days

2000 Using Avg Flow & Elev	
Average Flow	6862
Average Elevation	561.77
Volume	123101
Retention Time	
	18 days

2007 Using Avg Flow & Elev	
Average Flow	3918
Average Elevation	561.54
Volume	120105
Retention Time	
	31 days

(4)

(5)

Year	Average Inflow (Jan 1 - May 31)
1991	13734
1992	10779
1993	14720
1994	14317
1995	11069
1996	17040
1997	15453
1998	19401
1999	9610
2000	7236
2007	4324

Flow in the Coosa River at the Alabama - Georgia state line on May 30, 2007. 1165

General Test Laboratory
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(205) 664 - 6081

ALABAMA POWER
A SOUTHERN COMPANY

CERTIFICATE OF ANALYSIS

To: Mr. Bill Garrett
Mr. John Ponstein

Customer Account : CORM29
Sample Date : 30-May-07
Customer ID : COOSAALGA
Delivery Date : 30-May-07

Description: Coosa River Mile 29
Coosa river AL/GA 1225

Laboratory ID Number: AL16002

Name	Analyst	Test Date	Reference	Vio Spec	MDL	Results	Units
Metals, Cyanide, Total Phenols							
Aluminum, Total	FKK	5/31/2007	EPA 200.7		0.002	0.289	mg/l
Antimony, Total	FKK	5/31/2007	EPA 200.7		0.003	0.038	mg/l
Arsenic, Total	FKK	5/31/2007	EPA 200.7		0.004	Not Detected	mg/l
Barium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.085	mg/l
Beryllium, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Boron, Total	FKK	5/31/2007	EPA 200.7		0.004	Not Detected	mg/l
Cadmium, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Calcium, Total	FKK	5/31/2007	EPA 200.7		0.002	19.1	mg/l
Chromium, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Cobalt, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Copper, Total	FKK	5/31/2007	EPA 200.7		0.001	0.003	mg/l
Iron, Total	FKK	5/31/2007	EPA 200.7		0.002	0.222	mg/l
Lead, Total	FKK	5/31/2007	EPA 200.7		0.002	0.002	mg/l
Magnesium, Total	FKK	5/31/2007	EPA 200.7		0.002	5.87	mg/l
Manganese, Total	FKK	5/31/2007	EPA 200.7		0.001	0.067	mg/l
Molybdenum, Total	FKK	5/31/2007	EPA 200.7		0.01	Not Detected	mg/l
Nickel, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Potassium, Total	FKK	5/31/2007	EPA 200.7		0.001	2.42	mg/l
Selenium, Total	FKK	5/31/2007	EPA 200.7		0.005	Not Detected	mg/l
Silicon, Total	FKK	5/31/2007	EPA 200.7		0.002	2.32	mg/l
Silver, Total	FKK	5/31/2007	EPA 200.7		0.001	0.023	mg/l
Sodium, Total	FKK	5/31/2007	EPA 200.7		0.001	16.1	mg/l
Strontium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.075	mg/l
Thallium, Total	FKK	5/31/2007	EPA 200.7		0.002	Not Detected	mg/l
Tin, Total	FKK	5/31/2007	EPA 200.7		0.002	0.002	mg/l
Titanium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.009	mg/l
Vanadium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.005	mg/l
Zinc - Total	FKK	5/31/2007	EPA 200.7		0.001	0.024	mg/l

This Certificate is for the physical and/or chemical characteristics of the sample as submitted.

Comments:

cc:

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To: Mr. Bill Garrett
Mr. John Ponstein

Customer Account : CORM29
Sample Date : 30-May-07
Customer ID : COOSAALGA
Delivery Date : 30-May-07

Description: Coosa River Mile 29
Coosa river AL/GA 1225

Laboratory ID Number: AL16002

Name	Analyst	Test Date	Reference	Vio Spec	MDL	Results	Units
General Characteristics							
Dissolved Oxygen	JRW	5/30/2007	Field Test		1.0	8.42	mg/l
Hydroxide Alkalinity as CaCO3	BRB	5/31/2007	SM 4500		0.1	0.1	mg CaCO3/L
Conductivity	JRW	5/30/2007	EPA 120.1		0.	222	umhos/cm
Conductivity	BRB	5/31/2007	SM2510B		0.1	194	umhos/cm
Solids, Total	HRG	6/1/2007	EPA 160.3		1.	128.	mg/l
Bicarbonate Alkalinity, as CaCO3	BRB	5/31/2007	SM 4500		0.1	56.0	mg/l-CaCO3
Carbonate Alkalinity,as CaCO3	BRB	5/31/2007	SM 4500		0.1	1.2	mg/l-CaCO3
Turbidity	BRB	5/31/2007	EPA 180.1		0.30	4.2	NTU
Alkalinity, Total as CaCO3	BRB	5/31/2007	SM2320B		0.1	59.3	mg/l-CaCO3
Hardness, Total, (as CACO3)	FKK	5/31/2007	SM 2340 B			71.9	mg/l
Field pH	JRW	5/30/2007	EPA 150.1		0.00	7.82	SU
pH	BRB	5/31/2007	EPA 150.1		0.00	8.33	SU
Carbon Dioxide, Total	BRB	5/31/2007	SM 4500		0.1	52.1	mg CO2/L
Fluoride, Total	KRC	6/1/2007	EPA 300.0		0.010	0.070	mg/l
Phosphate - Ortho	HRG	5/31/2007	EPA 365.2		0.01	0.12	mg/l as P
Carbon Dioxide, Free	BRB	5/31/2007	SM 4500		0.1	0.5	mg CO2/L
Total Organic Carbon	KRC	6/1/2007	EPA 415.1		0.30	2.42	mg/l
Solids - Suspended	HRG	5/31/2007	EPA 160.2		1.	7.	mg/l
Nitrogen, Ammonia	KRC	6/1/2007	EPA 350.1		0.01	0.06	mg/l as N
Chloride	KRC	6/1/2007	EPA 300.0		0.03	6.65	mg/l
Field Temperature	JRW	5/30/2007	Field Data		0.	28.8	Deg. C.
Bromide	KRC	6/1/2007	EPA 300.0		0.010	0.050	mg/l
Nitrogen, Nitrate/Nitrite	KRC	5/31/2007	353.2		0.01	0.25	mg/l as N
Phosphorus, Total	HRG	5/31/2007	EPA 365.2		0.01	0.14	mg/l as P
Sulfate	KRC	6/1/2007	EPA 300.0		0.03	23.78	mg/l
Nitrogen, Total Kjeldahl	KRC	6/1/2007	EPA 351.2		0.01	0.53	mg/l as N
Miscellaneous							
Chlorophyll A,Spectro, Uncorrect	BRB	6/1/2007	SM 10200H			45.4	mg/M3

This Certificate is for the physical and/or chemical characteristics of the sample as submitted.

Comments:

mg/m³ ≟ mg/l
10⁻³ mg / l

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CERTIFICATE OF ANALYSIS

To: Mr. Bill Garrett
Mr. John Ponstein

Customer Account : CORM29
Sample Date : 30-May-07
Customer ID : COOSAALGA
Delivery Date : 30-May-07

Description: Coosa River Mile 29 .
Coosa river AL/GA 1225

Laboratory ID Number: AL16002

Name	Analyst	Test Date	Reference	Vio Spec	MDL	Results	Units
Miscellaneous							
Chlorophyll A, Spectro, Correctd	BRB	6/1/2007	SM 10200H			32.4	mg/M3
Pigment Ratio	BRB	6/1/2007	SM 10200H			1.6	SU

This Certificate is for the physical and/or chemical characteristics of the sample as submitted.

Comments:

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CERTIFICATE OF ANALYSIS

To: Mr. Bill Garrett
Mr. John Ponstein

Customer Account : CORM29
Sample Date : 30-May-07
Customer ID : COOSAALGA
Delivery Date : 30-May-07

Description: Coosa River Mile 29
Coosa river AL/GA 1230

Laboratory ID Number: AL16003

Name	Analyst	Test Date	Reference	Vio Spec	MDL	Results	Units
Metals, Cyanide, Total Phenols							
Aluminum, Total	FKK	5/31/2007	EPA 200.7		0.002	0.290	mg/l
Antimony, Total	FKK	5/31/2007	EPA 200.7		0.003	0.024	mg/l
Arsenic, Total	FKK	5/31/2007	EPA 200.7		0.004	Not Detected	mg/l
Barium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.086	mg/l
Beryllium, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Boron, Total	FKK	5/31/2007	EPA 200.7		0.004	Not Detected	mg/l
Cadmium, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Calcium, Total	FKK	5/31/2007	EPA 200.7		0.002	19.2	mg/l
Chromium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.001	mg/l
Cobalt, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Copper, Total	FKK	5/31/2007	EPA 200.7		0.001	0.004	mg/l
Iron, Total	FKK	5/31/2007	EPA 200.7		0.002	0.249	mg/l
Lead, Total	FKK	5/31/2007	EPA 200.7		0.002	Not Detected	mg/l
Magnesium, Total	FKK	5/31/2007	EPA 200.7		0.002	5.93	mg/l
Manganese, Total	FKK	5/31/2007	EPA 200.7		0.001	0.069	mg/l
Molybdenum, Total	FKK	5/31/2007	EPA 200.7		0.01	Not Detected	mg/l
Nickel, Total	FKK	5/31/2007	EPA 200.7		0.001	0.001	mg/l
Potassium, Total	FKK	5/31/2007	EPA 200.7		0.001	2.61	mg/l
Selenium, Total	FKK	5/31/2007	EPA 200.7		0.005	Not Detected	mg/l
Silicon, Total	FKK	5/31/2007	EPA 200.7		0.002	2.41	mg/l
Silver, Total	FKK	5/31/2007	EPA 200.7		0.001	0.010	mg/l
Sodium, Total	FKK	5/31/2007	EPA 200.7		0.001	16.3	mg/l
Strontium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.075	mg/l
Thallium, Total	FKK	5/31/2007	EPA 200.7		0.002	Not Detected	mg/l
Tin, Total	FKK	5/31/2007	EPA 200.7		0.002	0.002	mg/l
Titanium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.011	mg/l
Vanadium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.005	mg/l
Zinc - Total	FKK	5/31/2007	EPA 200.7		0.001	0.030	mg/l

This Certificate is for the physical and/or chemical characteristics of the sample as submitted.

Comments:

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ALABAMA POWER
A SOUTHERN COMPANY

CERTIFICATE OF ANALYSIS

To: Mr. Bill Garrett
Mr. John Ponstein

Customer Account : CORM29
Sample Date : 30-May-07
Customer ID : COOSAALGA
Delivery Date : 30-May-07

Description: Coosa River Mile 29
Coosa river AL/GA 1230

Laboratory ID Number: AL16003

Name	Analyst	Test Date	Reference	Vio Spec	MDL	Results	Units
General Characteristics							
Dissolved Oxygen	JRW	5/30/2007	Field Test		1.0	8.42	mg/l
Hydroxide Alkalinity as CaCO3	BRB	5/31/2007	SM 4500		0.1	0.1	mg CaCO3/L
Conductivity	BRB	5/31/2007	SM2510B		0.1	192	umhos/cm
Conductivity	JRW	5/30/2007	EPA 120.1		0.	222	umhos/cm
Solids, Total	HRG	6/1/2007	EPA 160.3		1.	142.	mg/l
Bicarbonate Alkalinity, as CaCO3	BRB	5/31/2007	SM 4500		0.1	58.0	mg/l-CaCO3
Carbonate Alkalinity,as CaCO3	BRB	5/31/2007	SM 4500		0.1	1.1	mg/l-CaCO3
Turbidity	BRB	5/31/2007	EPA 180.1		0.30	4.4	NTU
Alkalinity, Total as CaCO3	BRB	5/31/2007	SM2320B		0.1	59.2	mg/l-CaCO3
Hardness, Total, (as CACO3)	FKK	5/31/2007	SM 2340 B			72.4	mg/l
Field pH	JRW	5/30/2007	EPA 150.1		0.00	7.82	SU
pH	BRB	5/31/2007	EPA 150.1		0.00	8.30	SU
Carbon Dioxide, Total	BRB	5/31/2007	SM 4500		0.1	52.1	mg CO2/L
Fluoride, Total	KRC	6/1/2007	EPA 300.0		0.010	0.070	mg/l
Phosphate - Ortho	HRG	5/31/2007	EPA 365.2		0.01	0.12	mg/l as P
Carbon Dioxide, Free	BRB	5/31/2007	SM 4500		0.1	0.6	mg CO2/L
Total Organic Carbon	KRC	6/1/2007	EPA 415.1		0.30	2.60	mg/l
Solids - Suspended	HRG	5/31/2007	EPA 160.2		1.	6.	mg/l
Nitrogen, Ammonia	KRC	6/1/2007	EPA 350.1		0.01	0.05	mg/l as N
Chloride	KRC	6/1/2007	EPA 300.0		0.03	8.69	mg/l
Field Temperature	JRW	5/30/2007	Field Data		0.	28.8	Deg. C.
Bromide	KRC	6/1/2007	EPA 300.0		0.010	0.050	mg/l
Nitrogen, Nitrate/Nitrite	KRC	5/31/2007	353.2		0.01	0.25	mg/l as N
Phosphorus, Total	HRG	5/31/2007	EPA 365.2		0.01	0.13	mg/l as P
Sulfate	KRC	6/1/2007	EPA 300.0		0.03	23.62	mg/l
Nitrogen, Total Kjeldahl	KRC	6/1/2007	EPA 351.2		0.01	0.58	mg/l as N
Miscellaneous							
Chlorophyll A,Spectro, Uncorrect	BRB	6/1/2007	SM 10200H			45.6	mg/M3

This Certificate is for the physical and/or chemical characteristics of the sample as submitted.

Comments:

cc:

Quality Control ____________________ Supervision ______________________ Date: 01-Jun-07

smk/NC

SUPPAR012270

General Test Laboratory
P.O. Box 2641
Birmingham, Alabama 35291
(205) 664 - 6081

ALABAMA POWER
A SOUTHERN COMPANY

CERTIFICATE OF ANALYSIS

To: Mr. Bill Garrett
Mr. John Ponstein

Customer Account : CORM29
Sample Date : 30-May-07
Customer ID : COOSAALGA
Delivery Date : 30-May-07

Description: Coosa River Mile 29
Coosa river AL/GA 1230

Laboratory ID Number: AL16003

Name	Analyst	Test Date	Reference	Vio Spec	MDL	Results	Units
Miscellaneous							
Chlorophyll A, Spectro, Correctd	BRB	6/1/2007	SM 10200H			33.4	mg/M3
Pigment Ratio	BRB	6/1/2007	SM 10200H			1.6	SU

This Certificate is for the physical and/or chemical characteristics of the sample as submitted.

Comments:

cc:

Quality Control ____________________ Supervision____________________ Date: 01-Jun-07

smk/NC

SUPPAR012271

General Test Laboratory
P.O. Box 2641
Birmingham, Alabama 35291
(205) 664 - 6081

ALABAMA POWER
A SOUTHERN COMPANY

CERTIFICATE OF ANALYSIS

To: Mr. Bill Garrett
Mr. John Ponstein

Customer Account : CORM29
Sample Date : 30-May-07
Customer ID : COOSAALGA
Delivery Date : 30-May-07

Description: Coosa River Mile 29
Coosa river AL/GA 1235

Laboratory ID Number: AL16004

Name	Analyst	Test Date	Reference	Vio Spec	MDL	Results	Units
Metals, Cyanide, Total Phenols							
Aluminum, Total	FKK	5/31/2007	EPA 200.7		0.002	0.267	mg/l
Antimony, Total	FKK	5/31/2007	EPA 200.7		0.003	0.020	mg/l
Arsenic, Total	FKK	5/31/2007	EPA 200.7		0.004	Not Detected	mg/l
Barium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.086	mg/l
Beryllium, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Boron, Total	FKK	5/31/2007	EPA 200.7		0.004	Not Detected	mg/l
Cadmium, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Calcium, Total	FKK	5/31/2007	EPA 200.7		0.002	19.4	mg/l
Chromium, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Cobalt, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Copper, Total	FKK	5/31/2007	EPA 200.7		0.001	0.002	mg/l
Iron, Total	FKK	5/31/2007	EPA 200.7		0.002	0.235	mg/l
Lead, Total	FKK	5/31/2007	EPA 200.7		0.002	Not Detected	mg/l
Magnesium, Total	FKK	5/31/2007	EPA 200.7		0.002	5.98	mg/l
Manganese, Total	FKK	5/31/2007	EPA 200.7		0.001	0.067	mg/l
Molybdenum, Total	FKK	5/31/2007	EPA 200.7		0.01	Not Detected	mg/l
Nickel, Total	FKK	5/31/2007	EPA 200.7		0.001	Not Detected	mg/l
Potassium, Total	FKK	5/31/2007	EPA 200.7		0.001	2.50	mg/l
Selenium, Total	FKK	5/31/2007	EPA 200.7		0.005	Not Detected	mg/l
Silicon, Total	FKK	5/31/2007	EPA 200.7		0.002	2.39	mg/l
Silver, Total	FKK	5/31/2007	EPA 200.7		0.001	0.006	mg/l
Sodium, Total	FKK	5/31/2007	EPA 200.7		0.001	16.6	mg/l
Strontium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.076	mg/l
Thallium, Total	FKK	5/31/2007	EPA 200.7		0.002	Not Detected	mg/l
Tin, Total	FKK	5/31/2007	EPA 200.7		0.002	0.003	mg/l
Titanium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.010	mg/l
Vanadium, Total	FKK	5/31/2007	EPA 200.7		0.001	0.005	mg/l
Zinc - Total	FKK	5/31/2007	EPA 200.7		0.001	0.026	mg/l

This Certificate is for the physical and/or chemical characteristics of the sample as submitted.

Comments:

cc:

Quality Control ______________________ **Supervision**____________________________ **Date:** 01-Jun-07

smk/NC

SUPPAR012272

General Test Laboratory
P.O. Box 2641
Birmingham, Alabama 35291
(205) 664 - 6081

ALABAMA POWER
A SOUTHERN COMPANY

CERTIFICATE OF ANALYSIS

To: Mr. Bill Garrett
Mr. John Ponstein

Customer Account : CORM29
Sample Date : 30-May-07
Customer ID : COOSAALGA
Delivery Date : 30-May-07

Description: Coosa River Mile 29
Coosa river AL/GA 1235

Laboratory ID Number: AL16004

Name	Analyst	Test Date	Reference	Vio Spec	MDL	Results	Units
General Characteristics							
Dissolved Oxygen	JRW	5/30/2007	Field Test		1.0	8.42	mg/l
Hydroxide Alkalinity as CaCO3	BRB	5/31/2007	SM 4500		0.1	0.1	mg CaCO3/L
Conductivity	BRB	5/31/2007	SM2510B		0.1	197	umhos/cm
Conductivity	JRW	5/30/2007	EPA 120.1		0.	222	umhos/cm
Solids, Total	HRG	6/1/2007	EPA 160.3		1.	143.	mg/l
Bicarbonate Alkalinity, as CaCO3	BRB	5/31/2007	SM 4500		0.1	65.5	mg/l-CaCO3
Carbonate Alkalinity,as CaCO3	BRB	5/31/2007	SM 4500		0.1	1.3	mg/l-CaCO3
Turbidity	BRB	5/31/2007	EPA 180.1		0.30	4.0	NTU
Alkalinity, Total as CaCO3	BRB	5/31/2007	SM2320B		0.1	67.0	mg/l-CaCO3
Hardness, Total, (as CACO3)	FKK	5/31/2007	SM 2340 B			73.1	mg/l
Field pH	JRW	5/30/2007	EPA 150.1		0.00	7.82	SU
pH	BRB	5/31/2007	EPA 150.1		0.00	8.34	SU
Carbon Dioxide, Total	BRB	5/31/2007	SM 4500		0.1	58.8	mg CO2/L
Fluoride, Total	KRC	6/1/2007	EPA 300.0		0.010	0.070	mg/l
Phosphate - Ortho	HRG	5/31/2007	EPA 365.2		0.01	0.12	mg/l as P
Carbon Dioxide, Free	BRB	5/31/2007	SM 4500		0.1	0.6	mg CO2/L
Total Organic Carbon	KRC	6/1/2007	EPA 415.1		0.30	2.68	mg/l
Solids - Suspended	HRG	5/31/2007	EPA 160.2		1.	9.	mg/l
Nitrogen, Ammonia	KRC	6/1/2007	EPA 350.1		0.01	0.05	mg/l as N
Chloride	KRC	6/1/2007	EPA 300.0		0.03	8.77	mg/l
Field Temperature	JRW	5/30/2007	Field Data		0.	28.8	Deg. C.
Bromide	KRC	6/1/2007	EPA 300.0		0.010	0.050	mg/l
Nitrogen, Nitrate/Nitrite	KRC	5/31/2007	353.2		0.01	0.24	mg/l as N
Phosphorus, Total	HRG	5/31/2007	EPA 365.2		0.01	0.13	mg/l as P
Sulfate	KRC	6/1/2007	EPA 300.0		0.03	23.66	mg/l
Nitrogen, Total Kjeldahl	KRC	6/1/2007	EPA 351.2		0.01	0.68	mg/l as N
Miscellaneous							
Chlorophyll A,Spectro, Uncorrect	BRB	6/1/2007	SM 10200H			40.7	mg/M3

This Certificate is for the physical and/or chemical characteristics of the sample as submitted.

Comments:

cc:

Quality Control ________________ Supervision________________ Date: 01-Jun-07

smk/NC

SUPPAR012273

General Test Laboratory
P.O. Box 2641
Birmingham, Alabama 35291
(205) 664 - 6081

ALABAMA POWER
A SOUTHERN COMPANY

CERTIFICATE OF ANALYSIS

To: Mr. Bill Garrett
Mr. John Ponstein

Customer Account : CORM29
Sample Date : 30-May-07
Customer ID : COOSAALGA
Delivery Date : 30-May-07

Description: Coosa River Mile 29
Coosa river AL/GA 1235

Laboratory ID Number: AL16004

Name	Analyst	Test Date	Reference	Vio Spec	MDL	Results	Units
Miscellaneous							
Chlorophyll A, Spectro, Correctd	BRB	6/1/2007	SM 10200H			29.8	mg/M3
Pigment Ratio	BRB	6/1/2007	SM 10200H			1.6	SU

This Certificate is for the physical and/or chemical characteristics of the sample as submitted.

Comments:

cc:

Quality Control ____________________ **Supervision**________________________ **Date:** 01-Jun-07

smk/NC

SUPPAR012274

Dissolved oxygen / temperature profile*

Location: Coosa River near AL / GA state line (~RM 29.0)

GPS Coordinates: N 34.19939°, W 85.44420°

May 30, 2007 @ 12:30 CST

Depth (ft)	Dissolved Oxygen (mg/l)	Temperature (°C)
0	9.07	29.1
1	9.09	29.0
3	8.79	28.8
5	8.42	28.7
10	7.55	28.6
15	3.73	27.1
20	0.70	25.0
25	0.25	24.5

* Maximum river depth = 28 feet

3 Samples

5'

[illegible]

Water Quality

June 15 2007 e-mail to Bowers
****

-----Original Message-----
From: Sumner, Lewis C SAM
Sent: Friday, June 15, 2007 6:25 PM
To: 'wlbowers@southernco.com'; 'cmstover@southernco.com'
Subject: Request for reduced flows from APC reservoirs

Willard and Charles:

Reference is made to your request dated May 15, 2007, for Department of the Army authorization to reduce water releases from your reservoirs on the Tallapoosa and Coosa Rivers as a result of continuing drought conditions.

Your proposed reduction from the current flow agreement would constitute a Federal action that would potentially have impacts on the human and natural environment, and deviates from operations discussed in previous National Environmental Policy Act (NEPA) documentation. Therefore, in order to comply with the requirements of NEPA, Mobile District must evaluate the request through the preparation of an Environmental Assessment (EA).

We are requesting that you provide us with the following information to assist in our evaluation:

1. Describe the impacts of the No Action Alternative, i.e. impacts if no action is taken to grant the requested relief. Compare those impacts to the specific impacts or benefits to be achieved if the requested relief is granted. Although APC has clearly stated that the purpose of the reduced releases is to slow the fall of Alabama Power Company lake levels, you have not demonstrated what would be gained or at least avoided by the action. For example, if the purpose is to avoid loss of hydropower generation, provide data showing which populations would be affected, the numbers of people affected, dates by which service could be interrupted, etc., with the data correlated to predicted lake levels at specific dates, and whether the lost generation is practicably available for purchase from another source.

2. Please describe and analyze the cumulative and long term impacts of your requested action, on both rivers and lakes. Such discussion should include other related actions being considered within the ACT Basin, e.g., APC's recent request to FERC for reduction of the Jordan Dam continuous minimum flow from 2,000 cfs to 1,000 cfs. Also describe drought contingency planning or mitigation measures by water withdrawal users and dischargers that you are aware of, e.g., extending intakes into deeper waters, storage of effluent waters if flow gets too low, as well as, water conservation measures by municipal and industrial water users in the ACT Basin. Discuss future impacts of this action, should the drought persist as a multi-year event.

3. Provide information requested in 1 and 2 above for each of the proposed flow reductions of 10%, 20%, 30%, and 40%, as well as for the No Action alternative.

In order to assess the impacts of your request, we need Alabama Power assistance to answer or address the following issues and questions that have been raised during the Public Notice Comment Period.

U.S. Fish and Wildlife Service

1. Please provide information regarding potential impacts to the Alabama sturgeon, heavy pigtoe mussel and tulotoma snail; how the reduced flow would impact those species both directly from reduced flow and from the concentration of pollutants; and information regarding potential impacts to other species that occur downstream.

2. Please provide an assessment of the impacts to sport fisheries affected from the reservoirs to the tailraces, down the rivers, to the Mobile Tensaw Delta, to Mobile Bay. Further, describe the impacts to natural resources, including flora and fauna that could be affected by increasing salinity in the Mobile, Tombigbee and Alabama Rivers.

Department of Energy, Southeastern Power Administration (SEPA)

3. Please comment on statements to the effect that the proposed flow reduction would have direct adverse impacts on generation ability of both Millers Ferry and Robert F. Henry Dams, requiring the drafting of storage from the Corps-owned lakes Allatoona and Carters, resulting in shifting the burden of required releases from Alabama Power Company to Federal resources to the detriment of Federal customers and resulting in higher energy replacement costs for Federal customers; and the change in operation at Allatoona and Carters would dramatically effect peaking power production at the Federal projects, and because the Carters project especially, provides generation capacity beyond that of the combined the Alabama Power Company projects, could have great impacts to the Federal projects ability to provide hydropower generating flexibility.

4. Please comment on SEPA's remark that the proposed operational changes would cause customers of Federal hydropower to incur significant expenses for replacement energy costs.

Alabama Department of Environmental Management (ADEM)

5. Please comment on ADEM's remark that as stream flows decline there is potential for significant water quality degradation in a number of State of Alabama waterways. There is insufficient data to support the proposed 40% reduction in flow by Alabama Power Company.

Alabama Department of Conservation and Natural Resources (ADECA)

6. Please comment on ADECA's remark that a 40% reduction in flow on the Alabama River could be harmful to aquatic wildlife, and such a reduction would require additional study of the potential impacts to both freshwater and saltwater aquatic species.

Georgia Department of Natural Resources

7. Please comment on the remarks that the requested action has potential impacts to water supply for 500,000 Georgians by increased discharges from Lake Allatoona; the Corps must be conservative in making releases from Allatoona and Carters because of their location near the headwaters, with small drainage areas relative to conservation storage; and the watershed in Georgia is also suffering extreme drought conditions, further exacerbating the potential impacts to public water supply.

8. Please comment on the modeling by Georgia that shows that Alabama Power Company Lakes Weiss, H. Neely Henry, and Logan Martin would not be significantly improved by the proposed releases and that Alabama Power Company has provided no valid resource-based need for greater releases from the Corps lakes.

International Paper Company

9. Please comment on the impacts of flow reductions to International Paper Company plants. The proposed flow reduction would require the holding of an additional 15 million gallons of wastewater per day by the Prattville plant, at which holding ponds would become full by the end of July and plant production would then cease. The impact would affect the largest employer in Prattville, Alabama, including 800 employees, and 100 contractors, with a payroll of $42 million.

Southeastern Federal Power Customers, Inc.

10. Please comment on remarks to the effect that the proposed increased release from Lakes Allatoona and Carters would adversely affect power availability and cost to 238 rural electric cooperatives and municipalities throughout eight southeastern states,

including Alabama. The impact would occur because releases at this point in time would affect the affect the availability of hydropower production through the summer and potentially longer.

Weyerhaeuser Corporation Pine Hill Mill

11. Please comment on impacts of reduced flows that may affect the ability of the mill to withdraw water, which is used not only for the mill, but for supply of potable water to a community of approximately 16,000 people. Further, comment on impacts of 3000 cfs that may threaten mill production because wastewater may not be discharged when dissolved oxygen in the river falls below 5 mg/L.

Alabama River Pulp

12. Please comment on impacts to Alabama River Pulp, who states that flows resulting in water levels below 5.5 feet at the Claiborne tailrace will cause the company to shut down, leaving approximately 800 employees without work and loss of economic production at the plant of over $800,000 per day. Installation of supplemental pumps would cost over $132,000 plus $5,000 dollars per week to operate.

Your cooperation is appreciated and will help us expedite the evaluation of your request. If you have any questions please do not hesitate to call me at (251) 694-3857.

Chuck Sumner
U.S. Army Corps of Engineers, Mobile District

OFFICE OF THE GOVERNOR

BOB RILEY
GOVERNOR

STATE CAPITOL
MONTGOMERY, ALABAMA 36130

(334) 242-7100
FAX: (334) 242-0937

STATE OF ALABAMA

June 11, 2007

VIA FACSIMILE AND U.S. MAIL

Colonel Peter Taylor, District Engineer
Attention: Planning and Environmental Division
U.S. Army Engineer District, Mobile
P.O. Box 2288
Mobile, Alabama 36628-0001

Dear Colonel Taylor:

RE: Public Notice No. FP07-AC01-16

The State of Alabama submits these comments in response to the aspects of the public notice referenced above concerning additional releases from Allatoona Reservoir and Carters Lake.

The Alabama-Coosa-Tallapoosa (ACT) River Basin is experiencing drought conditions of historic proportions. On June 7, 2007, the U.S. Drought Monitor released its weekly report indicating that much of the ACT Basin located in Alabama is in the midst of an exceptional drought.

The flow in the Coosa River at the Alabama-Georgia state line, as measured by the gage at Mayo's Bar, reached an all-time low of 848 cubic feet per second (cfs) on June 5, 2007. That is more than 150 cfs below the previous all-time low for the month of June, and over 60 cfs below the previous all-time low for any month of 907 cfs during October 1988.

Alabama Power Company operates several projects in the ACT Basin. The attached diagrams show that the current elevations of those projects are extremely low relative to their historic levels for this time of year. Alabama Power projects that the level of each of them will continue to drop precipitously in the weeks ahead.

In contrast to the levels of the Alabama Power projects in the ACT Basin, the elevation at Allatoona Reservoir currently is above 837 feet. According to section 4-08 of the draft 1993 Allatoona Reservoir Water Control Manual ("draft 1993 manual"), that elevation indicates project conditions are "normal to wetter than normal."

Alabama's Office of Water Resources has recently been in contact with representatives of the Mobile District. When asked why the Corps has not been releasing more flow from Allatoona Reservoir, the Mobile District representative stated that the Corps is operating Allatoona Reservoir according to the applicable manual and that Alabama should expect the minimum releases from that reservoir in the coming weeks. Mr. Otto of the Mobile District confirmed on May 29, 2007, that the Corps claims to be operating Allatoona Reservoir consistent with the draft 1993 manual.

The State of Alabama has challenged the use of the draft 1993 manual because that manual has never been promulgated in accordance with applicable law. Although Alabama does not agree that the draft 1993 manual is properly in effect, Alabama cannot understand why the Corps is not adhering to the operational rules contained in that draft manual. If the Corps says that it is bound by that draft manual, then one would think the Corps would not repeatedly ignore it.

During May 2007, the elevation of Lake Allatoona was above 836 feet at all times, which is in Allatoona's Zone 1 for the month of May. According to Chart 1-11 in the draft 1993 manual, the Corps under such conditions is to make "normal conservation releases of water" in an amount "equivalent to between two and six hours of full powerhouse generation." Moreover, when Allatoona Reservoir falls into Zone 2, the Corps is to make releases for two hours peak hydropower generation each weekday, plus maintain a continuous release of 240 cfs.

Based on Alabama's review of the hydropower generation records for Allatoona Reservoir for May 2007, the Corps failed to follow the guidelines contained in the draft 1993 manual. Even though Allatoona Reservoir's elevation was in Zone 1 at all times during May, there were 21 days on which fewer than 2 hours of hydropower were generated, and there were 13 days on which zero hydropower was generated above the 240 cfs continuous flow requirement. As a result of the Corps' failure to follow its manual, over 7 billion gallons of water that should have flowed into Alabama during the month of May alone have been improperly withheld in Allatoona Reservoir. If one analyzes all of 2007, the shortfall of water that should have flowed into Alabama but has been withheld in Allatoona Reservoir exceeds 15 billion gallons.

This failure of the Corps to adhere to the terms of the draft 1993 manual it claims to be following has caused the flow at the Alabama-Georgia state line (as measured at Mayo's Bar) to drop to the all-time low described above. That failure has also contributed to the difficulty on the part of Alabama Power Company in meeting the navigation flow requirements in the Alabama River at Montgomery, and it has worsened water quality problems in Lake Weiss and other reservoirs on the Coosa River.

The draft 1993 manual expressly recognizes that "Allatoona Dam operations must be coordinated with the multiple projects in the Alabama-Coosa River Basin to insure the optimum benefits consistent with the physical characteristics and purposes for which the system was authorized." § 1-02. The draft manual expressly recognizes that the guideline releases for Allatoona "can at least partially mitigate water quality deficiencies [during periods of low flow] in the Coosa River" and "can often provide a significant portion" of the minimum flows in the Alabama River. §§ 5-04, 7-04.

As the Corps recognizes in the public notice, Alabama has requested that the Corps immediately increase it releases from Allatoona Reservoir and Carters Lake. Specifically, Alabama requests that the daily releases from those two projects total 1350 cfs. Such releases will fulfill the role for those reservoirs in drought conditions that the Corps itself has recognized in the draft 1993 manual. Not only will those releases provide much-needed support for water quality, fish and wildlife, industry, and navigation, but they will also enable increased hydropower generation during the summer season. Alabama suggests that the Corps commit to releases at the 1350 cfs level, subject to reevaluation after sixty days in light of then-existing conditions.

Should you have any questions about Alabama's position, please direct them to Brian Atkins, director of Alabama's Office of Water Resources.

Very truly yours,

Bob Riley

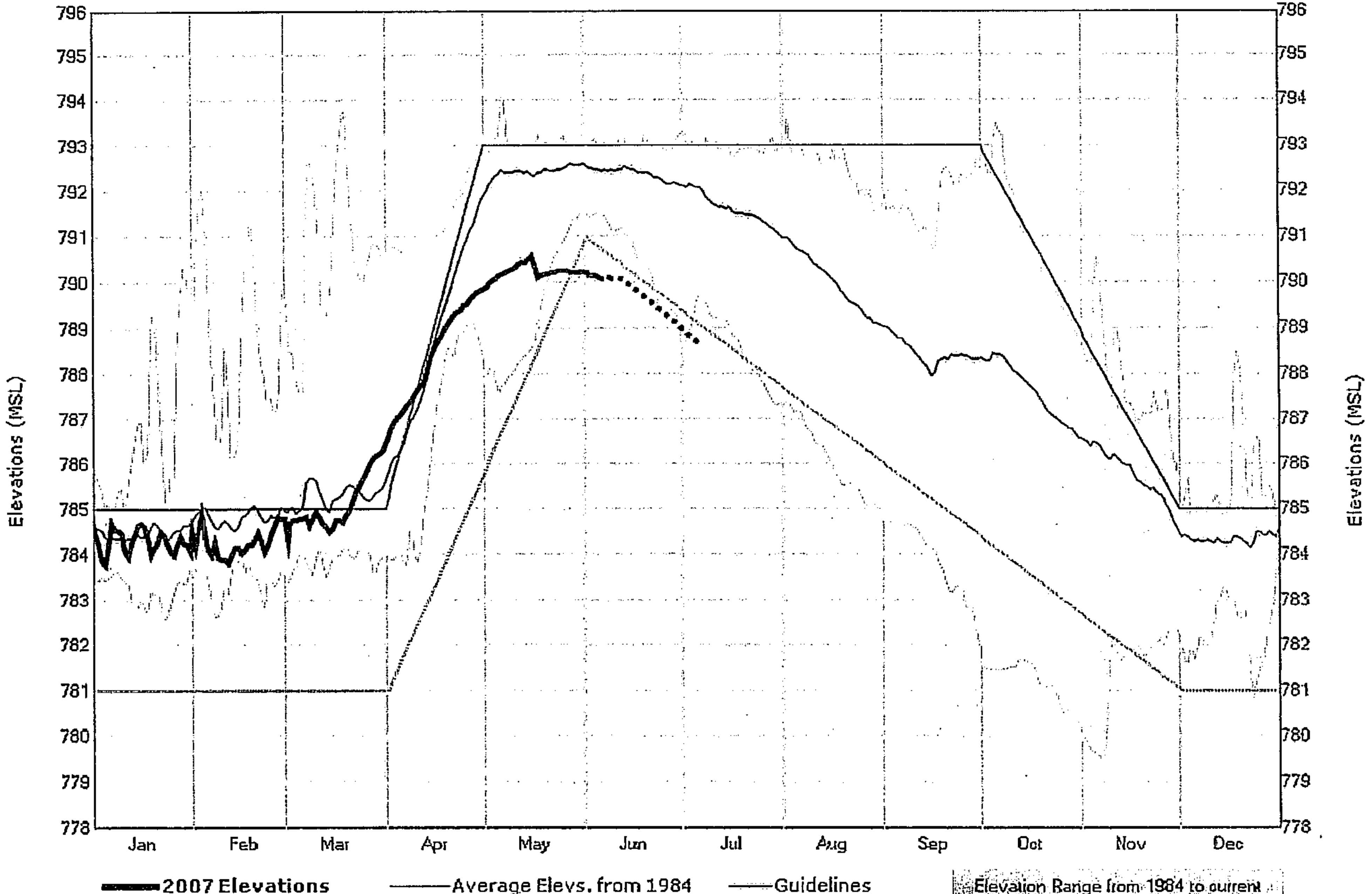
Bob Riley
Governor

BR/KW/rdg

Attachments

cc: Brig. Gen. Joseph Schroedel (via facsimile & U.S. Mail)

Alabama Power - HARRIS

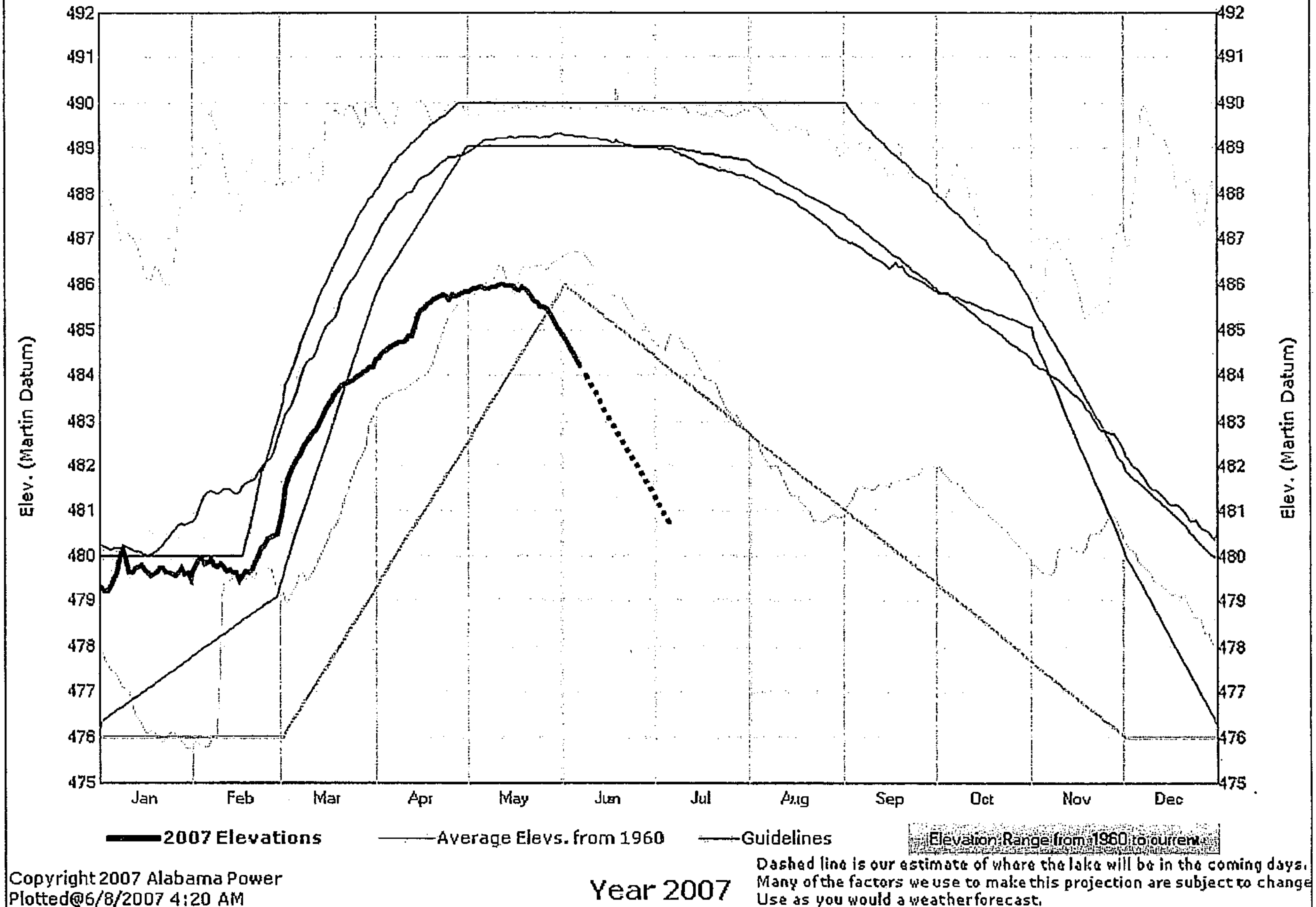


Dashed line is our estimate of where the lake will be in the coming days. Many of the factors we use to make this projection are subject to change. Use as you would a weatherforecast.

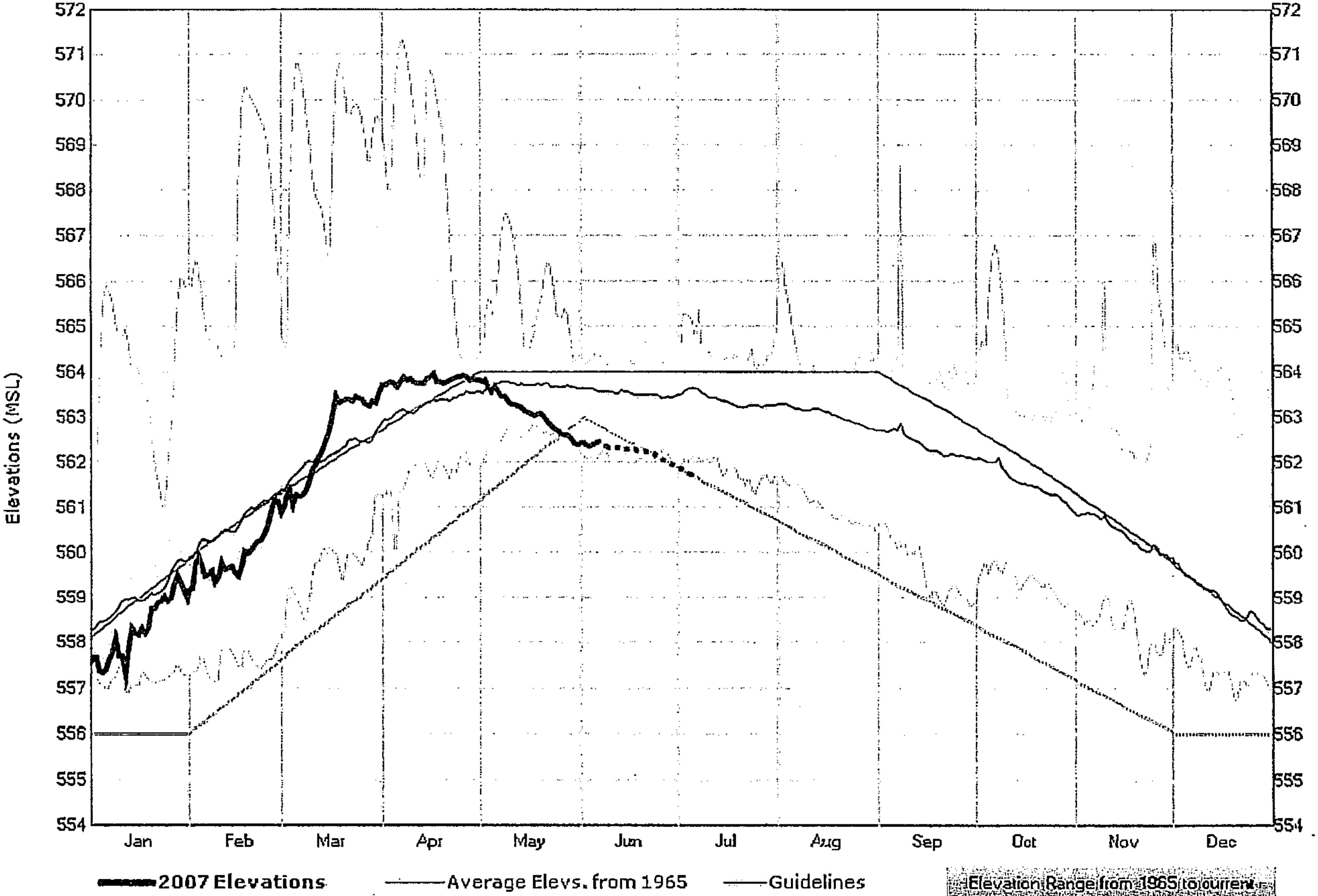
Year 2007

Plotted@6/8/2007 4:20 AM

Alabama Power - MARTIN



Alabama Power - WEISS

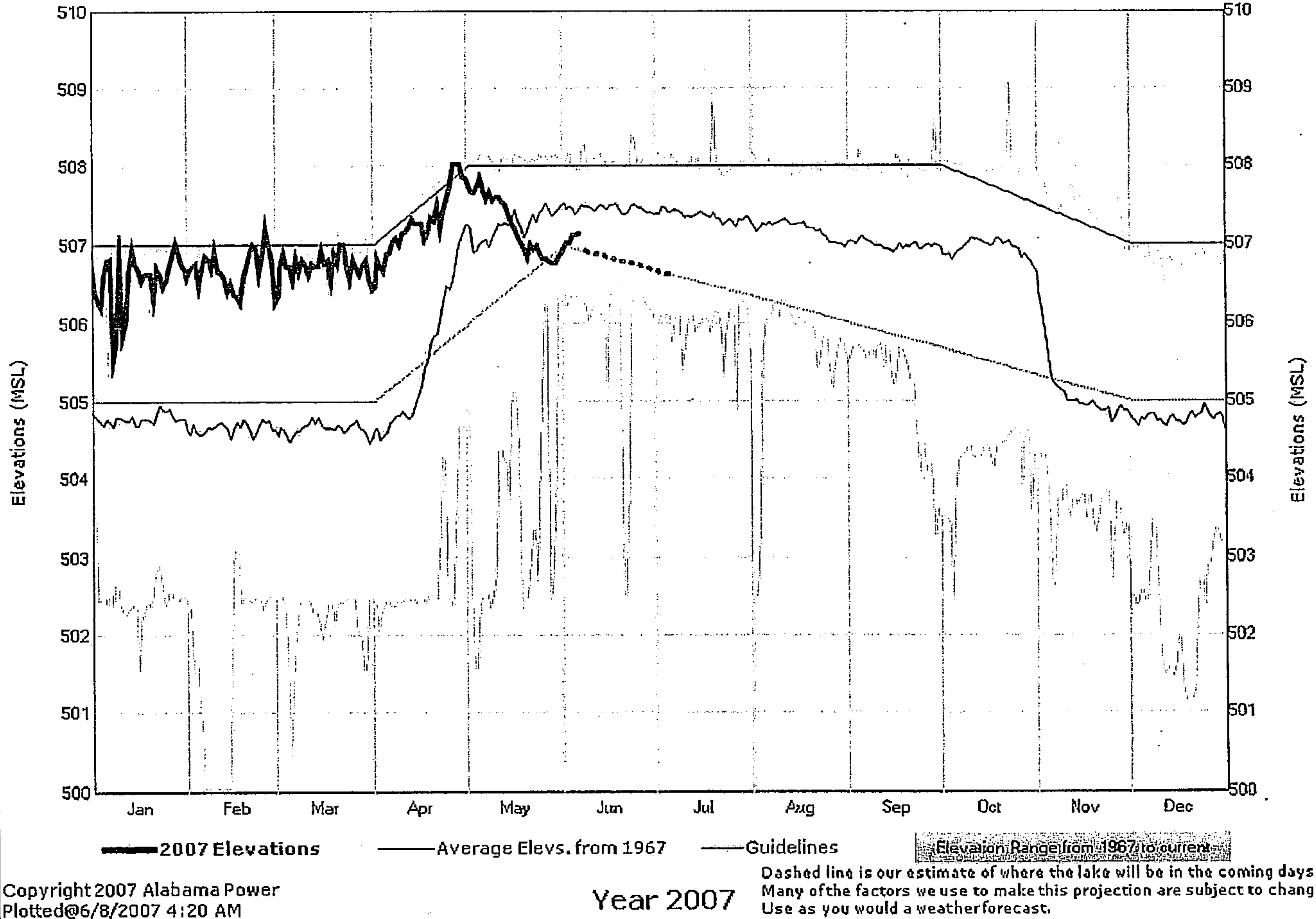


Year 2007

Dashed line is our estimate of where the lake will be in the coming days. Many of the factors we use to make this projection are subject to change. Use as you would a weather forecast.

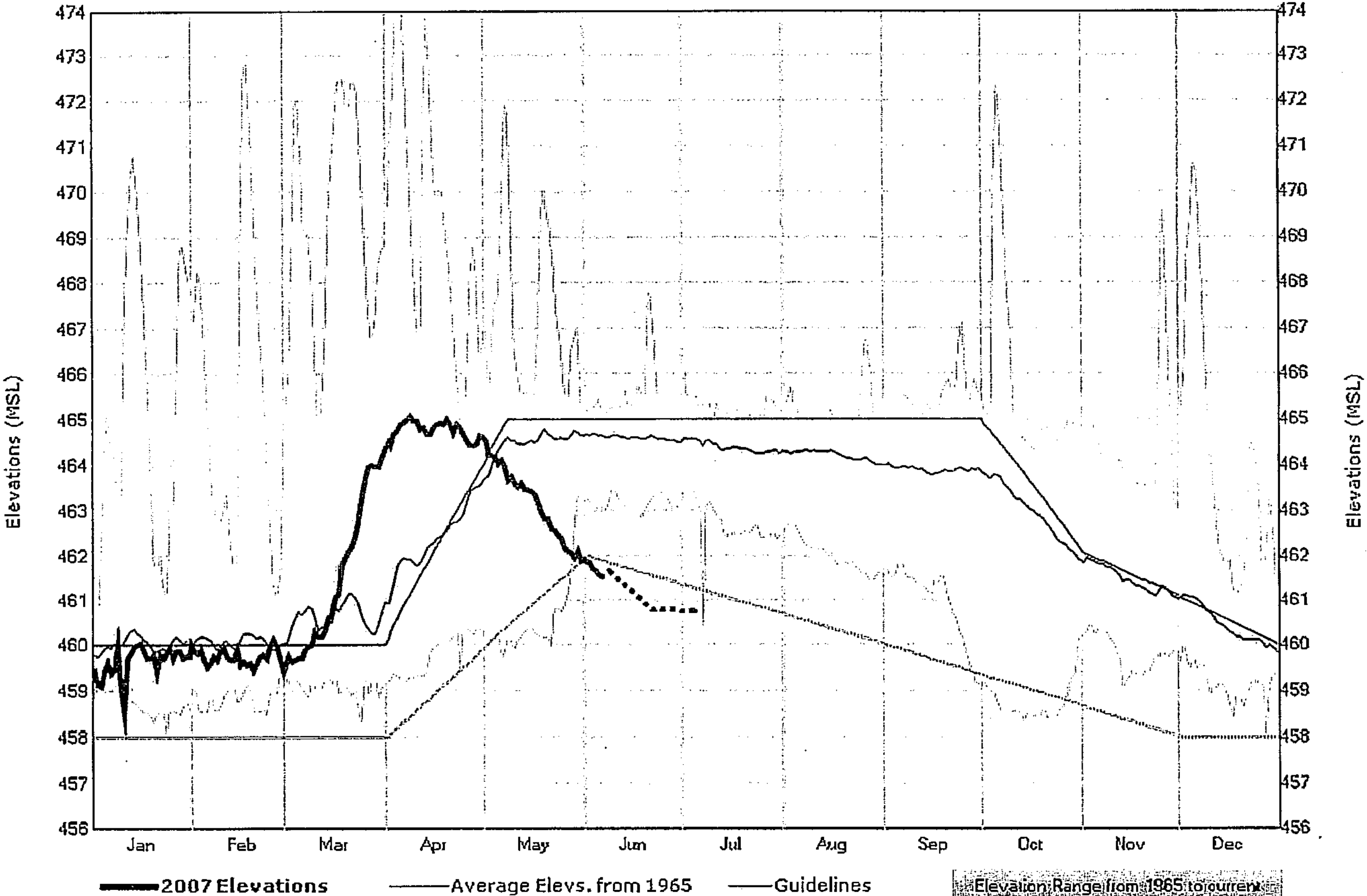
Plotted@6/8/2007 4:20 AM

Alabama Power - HENRY



Plotted@6/8/2007 4:20 AM

Alabama Power - LOGAN MARTIN

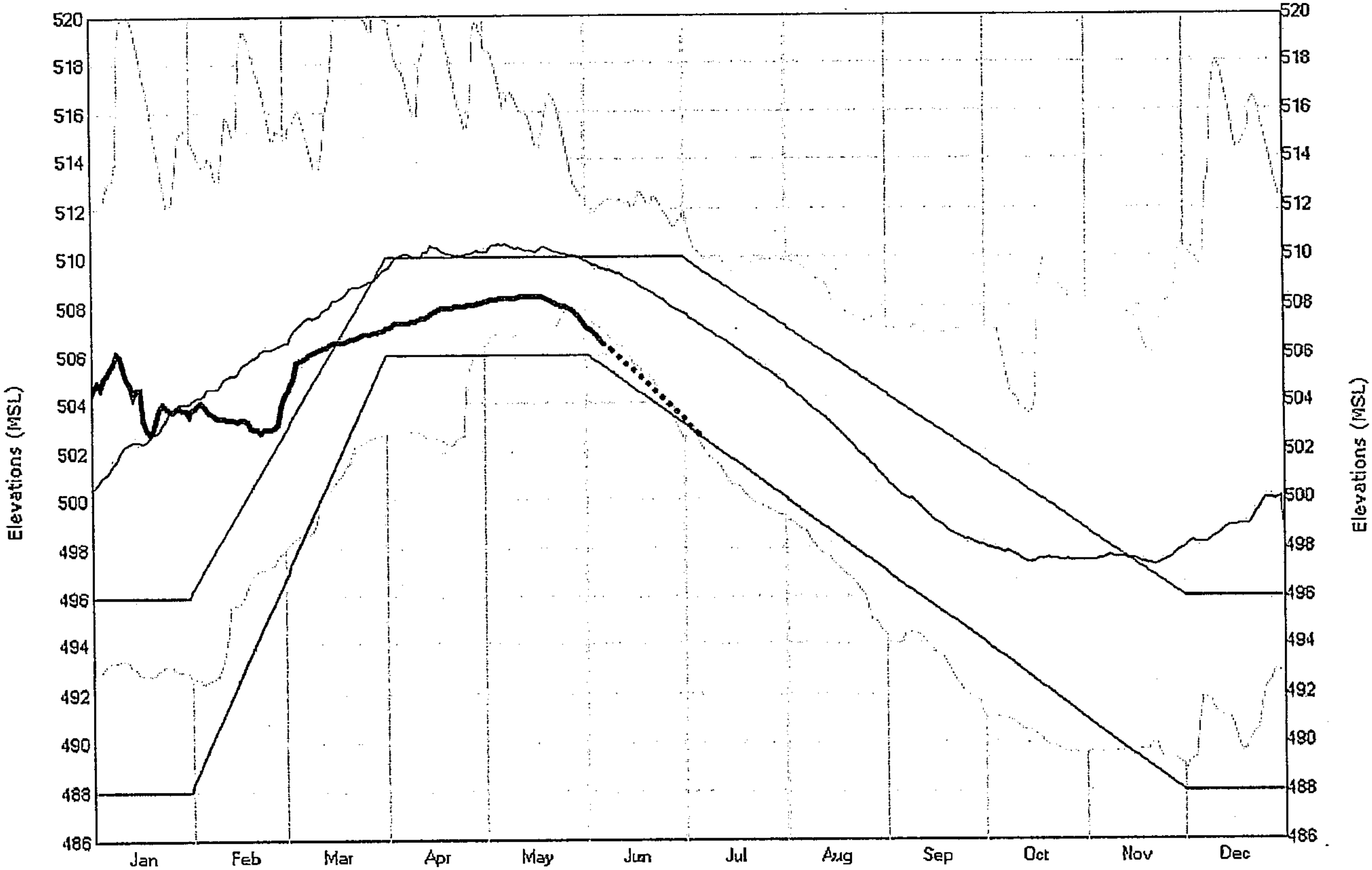


Dashed line is our estimate of where the lake will be in the coming days. Many of the factors we use to make this projection are subject to change. Use as you would a weather forecast.

Plotted@6/8/2007 4:20 AM

Year 2007

Alabama Power - SMITH



Dashed line is our estimate of where the lake will be in the coming days. Many of the factors we use to make this projection are subject to change. Use as you would a weather forecast.

Year 2007

Plotted@6/8/2007 4:20 AM

CESAM-PD 27 June 2007

MEMORANDUM FOR RECORD

SUBJECT: Alabama Coosa-Tallapoosa (ACT) Drought Summit, 25 June 2007, Columbus, Ga.

DRAFT

1. Attendees: (See attached list)

2. Mobile District command comments and introduction of Mobile Team: General Schroedel opened the summit and briefly discussed the purpose of the meeting. The main purpose was to establish a process for sharing information. He indicated the need to work together and to have a common picture of the system. He also emphasized that this summit was not to evaluate Corps decisions or answer pending questions and that the Corps is neither a referee nor a mediator for other parties. The General's PowerPoint presentation, as well as Doug Otto's, is available at the following address:

http://www.sam.usace.army.mil/pd/Pdl.htm.

The General stated that our commitment is to serve the public, be transparent in communications, listen to concerns, and make sound decisions. Commander's intent is to succeed as a region, invest in people, build trust and leverage resources. The Corps role is not that of a referee. The convened group is to exchange information and share concerns, and is not for the purpose of decision making, as that would raise concerns regarding the Federal Advisory Committee Act.

He also spoke about south Florida's drought as an example of establishing a communication process to improve interagency coordination. The State of Florida asked for lowering water levels in Water Conservation Areas. Set up weekly conference calls with SAD, SAJ, the State of Florida, and the South Florida Water Management District. A key issue is the prevention of salt water intrusion into drinking water wells.

3. ACT System Status/Prognosis: Colonel Pete Taylor presented the objectives and agenda for the meeting, had participants introduce themselves, and introduced Doug Otto. Doug used a Powerpoint presentation to summarize the status of the drought; ACT System operation; and key constraints identified to date. Doug spoke about U.S. drought monitoring. Alabama and Georgia are currently in an exceptional drought period, particularly centered over the ACT Basin. Prognosis is not good for the short term. Long term drought is extreme case. Much lower than normal rainfall amounts are expected this year.

- Current releases of 300 to 350 cfs daily released from Carters Lake. Lake Allatoona is currently releasing about 500-600 cfs. Carters Lake has a small drainage basin and lake levels continue to drop. Inflows coming into both of these Corps reservoirs are at or below the historic low for this time of year.

- Information was presented for each of the Corps and Alabama Power Company reservoirs in the ACT basin with data such as project rule curve, lake level to date this year, projected reservoir levels over the next month, hydropower production capability, key water supply intake elevations, remaining storage, and elevation of the bottom on conservation pool.

- River levels are low in the ACT Basin, with unregulated tributaries such as the Cahaba River experiencing record low flows.

- Constraints/Issues for drought operations: On the Alabama River, endangered species, municipal water intake elevations, pulp and paper industry intake elevations and wastewater assimilative capacity (river flow more pertinent than elevation for discharging effluent), with flow cutbacks more than 20 percent at Montgomery creating adverse impacts on these industries. Discussed water intake elevations for several municipalities. Several have multiple level intakes and should be ok if lower level intakes are functional. Wedowee's intake at Lake Harris could be exposed by end of July or early August.

- Dissolved Oxygen (DO) may be limit for production at some mills. River depth is a limiting factor for navigation on the Alabama River, as well as for the water intake at Alabama River Pulp (requiring 5.5 feet stage on the Claiborne gage).

4. Comments from attendees

a. Carol Couch - Georgia Environmental Protection Division (EPD): Spoke of water storage for public drinking water use as being number one priority. Over 800,000 people in northwest Georgia almost exclusively depend on Allatoona and Carters Lakes for their water supply. We should be considering the possibilities that the current drought could be a multiyear event, and as such should be practicing very cautious preservation of the remaining storage in these lakes. Aggressive restrictions have been placed on water usage (Conservation) by the State of Georgia. Need to identify triggers that would indicate reducing the outflows at Allatoona and Carters to the minimum flows of 240 cfs at each lake.

   Encouraged Corps to only release at-site minimums. Need to discuss factors that bear on minimum flows. Asked questions about flow requirements for T&E and if there are any benchmarks. She reiterated the consistency of the word "balance" as a thread used by all speakers. Recommend that in developing this balance, we need to set "priorities" for water use.

b. Willard Bowers - Alabama Power Company (APC): Mentioned that we are in 2nd year of drought. Brought up that Alabama Power previously asked for variance in Feb 2007. The variance was granted to fill lakes early, but the permission was withdrawn 4 hrs later. If drought continues, need relief from navigation flow requirements. Indicated that decision making needs to be addressed and how to get timely decisions. He noted that during the droughts in 1986 and 1988, no NEPA or public notices were required for the APC and Corps variances. Expressed concern that NEPA documentation was interfering with sound and timely decision making process.

   Operators need to come to logical answer on flows required. Steam plants have temperature restrictions for discharge waters, e.g., Barry Steam

Plant on the Mobile River. The drought has caused flows to get so low at that facility that negative flows have been observed, which could affect the plant's ability to operate within its NPDES permit temperature limits. Availability of hydropower production helps stabilize the overall power system within Alabama, so the hydropower function is not just about production of kilowatts. Recommend consideration of ways to provide relief in northern and central part of Alabama if downstream areas gets rain. Suggested that Corps reservoirs on the Alabama River be refilled to help protect the paper and pulp mills on the river.

c. Joel Seymour - South Eastern Power Administration (SEPA): Long term power contracts, 20 years, for federal dams. They are responsible for marketing of power produced at 10 projects in Alabama and Georgia. Noted that as reservoir elevations decline, also the hydropower efficiency declines, e.g., 25% decline at Lake Allatoona when the lake gets into the 828-830 foot elevation range. Under ideal conditions they like to operate the hydropeaking plants between 6-9am and 4-8 pm.

   SEPA markets power for 22 Federal projects in 11 states. Contracts have been made based on system operations and requirements Concerns when unanticipated drastic changes are made in water usage. They buy energy during drought periods. Participated in weekly "Drought Buster" telephone calls about hydro production. Must recover operating costs when have to purchase at high rates, such as during a hot, dry summer. Concerned about water studies and basin plans. Importance of integrated operations. Commented about refill times for reservoirs and integration of systems.

d. Daphne Smart - Alabama Department of Environmental Management (ADEM): Concerned about public water supply systems. Potentially 8 intakes on the Coosa could be affected, e.g., Gadsden, Childersburg, Talladega, Clanton, Elmore County (she will provide a list with information on elevation of intakes). Look for alternative water sources. Extend water intake lines to lower elevations. Water quality concerns. Seeing fish kills earlier than normal for this time of year. Concerned about NPDES discharge limitations for pulp and paper industries regarding their ability to comply with the DO permit limits.

Concerned that just by meeting/complying with emissions limits, we may not be protecting water quality and the aquatic resources since many areas are going below the 7Q10 flows for which the discharge limits were established. System needs to be managed as a whole and provide flows for longest time possible. Carol Couch asked about water conservation regulations and restrictions in Alabama. Daphne mentioned that although the state does not have water conservation laws, a number of cities and counties are enacting daily watering restrictions. ADEM has also sent letters to major industries regarding the drought conditions and the compliance with their permits. Carol Couch asked questions about flow requirements for T&E species and any benchmarks.

e. Sandy Tucker - USFWS (Georgia Office): Advocates for aquatic systems. Recommends early and often involvement with USFWS regarding endangered species consultation. They are concerned about impacts to minimum flows during drought conditions. Mentioned the need for identification of trigger to know when the drought is over and "normal" operations/releases could resume.

Water quality is also an issue. The three endangered species in Alabama River (Alabama sturgeon, heavy pigtoe, and tulatoma snail) are in a perilous state due to the drought, and this historic condition could be enough to drive these species to extinction. Want cooperative partnership.

f. Rick Oates - Alabama Pulp and Paper Council: Violation of permits by the paper and pulp industries is not an option - these mills would shut down rather than violate their NPDES permits. Need for balance in use of system especially in regards to flows. Economic impacts of thirteen mills are great for Alabama (landowners, loggers, truckers, etc.). One of the mills is on the Coosa and four on the Alabama River. The mill in Wilcox County also withdraws water for several communities' water supply. Communications are important.

g. Brian Atkins - Alabama Department of Economic and Community Affairs, Office of Water Resources (ADECA-OWR)): Ninety percent of Alabama is classified in extreme drought condition. Asked for more water releases from Corps projects in Georgia. Need more coordination and communication, earlier. Disconcerting to look at reservoir levels, especially Allatoona, which has been rising, and what was to be done as far as releases. Expressed desire to have increased releases from Carters and Allatoona. Confused as to what can be done to balance interests in regards to flow releases.

   Need to know what Corps' desires and expectations are and unclear on how the Corps is operating these upstream reservoirs. Stated that the Corps and stakeholders worked out drought operations during the 2000 drought without doing any NEPA documentation, which seems to be holding up the decision process during the current drought. Alabama has no state law or regulation requiring water conservation during droughts.

h. Jim Parsons - Cobb-County Marietta Water Authority, Atlanta Regional Commission (ARC): They see the main issue of the drought is one of water supply. Groundwater not an option for the highly populated area in north Georgia. Atlanta area economy is driven by water.

i. Tonya Blaylock -Georgia Power Company (GPC): Primary concern is steam plant (Plant Hammond and Plant Bowen) production and temperature permit limits on Coosa and Etowah Rivers. Run minimum loads as much as possible. Already they have had a temperature violation a couple of weeks ago at Plant Hammond (exceeded 90 degrees), a once-through cooling water process on the upper end of Weiss Lake in Georgia. Window of flexibility is very narrow. SER's in load reductions. Collaboration is important.

j. Barnett Lawley - Alabama Department of Conservation and National Resources (ADCNR): Oyster industry is adversely affected by salinity intrusion induced by the drought causing increased oyster predator populations. Priorities need to be established. Communication is important.

k. Kirk Cooper - Federal Energy Regulatory Commission (FERC): Reported that APC has had two minimum flow variances for Jordan Dam approved by FERC this Spring, and a third requests was submitted by APC last Friday - proposing to reduce the minimum flow from 2,000 cfs to 1,000 cfs, in 250 cfs increments associated with monitoring.

l. Dee Stewart - Environmental Protection Agency (EPA): Involved with water quantity in relation to water quality. Most of USEPA's regulatory responsibilities have been passed along to appropriate State agencies such as GEPD and ADEM. Concerned that public gets safe drinking water. Interested in working out issues with people.

5. Discussion of Process

a. DDE Butler provided a summary of the meeting. Reiterated listening to all concerns and the process of translating these concerns. Raised several rhetorical questions: How do we meet everyone's goals. How do we manage risks? Evaluate alternatives, e.g., extending water intakes into deeper water, use of gas turbines as alternative to hydro. What are the critical/trigger levels? What are the break points? Stressed better communication, quick decisions and fully coordinated responses.

b. General Schroedel suggested that more coordination from higher levels be initiated after technical experts have met. Decisions should be anticipated 3-4 wks in advance. Initiate teleconference to make assumptions and share them with users. Rationale for making decisions should also be discussed.

Need to be consistent with our decisions and approaches across the region. Need to think/get outside of the box. Set priorities with human water usage being the most important. Establish a southern coalition to let Congress know that water supply is a great issue and should be a national one. Envisions a need to doubling of water storage in the southeastern US over the next 20 years to address water supply issues.

6. <u>Conclusions:</u>

- Comment- In trying to address technical issues, technical people have constraints on what can be shared. (Willard Bowers)

- Comment - Be clear about what we are trying to do and how that information will be used. (Sandy Tucker)

- Comment/Question - Is there one place that shows constraints on system and requirements available? Need to capture these constraints in useable location. (Phil Mancusi-Ungaro (USEPA)

- Comment- No idea when drought will end. What are future needs and how do we get there. Future is just as important as the present. (Joel Seymour)

- Suggestions - Not enough communication is ongoing. Reiterated General's goals of meeting. Needs to reassess is the teleconference is not working. How to solve a particular need with concerns from other entities (unfavorable)? Need to quantify needs of system (personnel). (Carol Couch)

7. <u>Tasker/Action Items:</u>

- Task- Set up a conference call in about two weeks to further discuss the drought situation and share data.

- Missing from meeting: United Stated Geological Survey (USGS), navigation interests, and recreation interests.

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ALABAMA-COOSA RIVER BASIN

RESERVOIR REGULATION MANUAL

Prepared in the Mobile District, Corps of Engineers, DA,
Mobile, Alabama, December 1951

Date	Revisions and Additions

ALABAMA-COOSA RIVER BASIN

RESERVOIR REGULATION MANUAL

AUTHORIZATION

1. This reservoir regulation manual is prepared in accordance with paragraph 4220.01 of Orders and Regulations; paragraphs 6-01 through 6-03 of draft of section of Engineer Manual, Part CXXXVI; and paragraphs 3-02 and 3-03 of "Reservoir Regulation (Preliminary Issue: January 1948)," issued by the Office, Chief of Engineers.

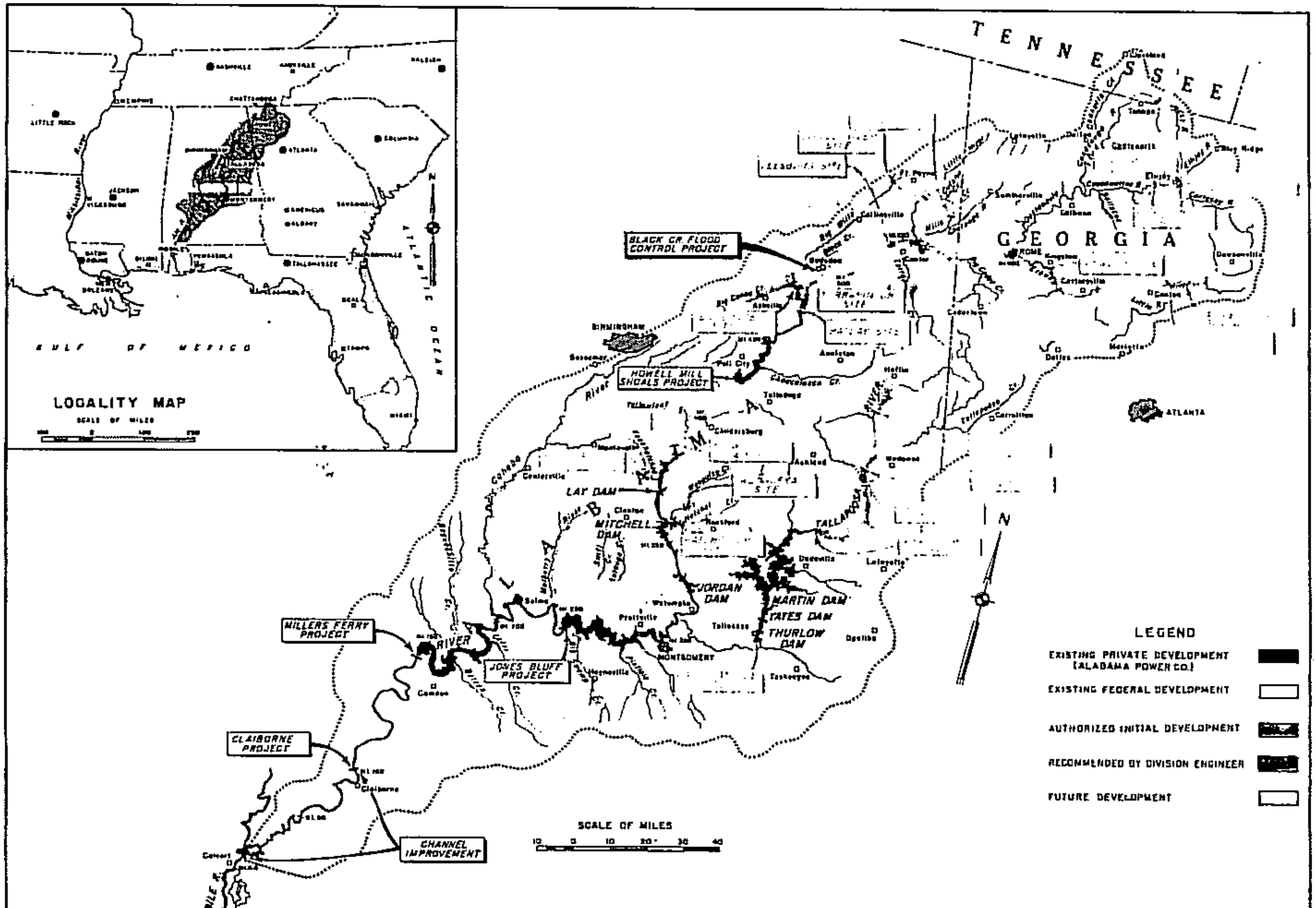
DESCRIPTION OF ALABAMA-COOSA RIVER BASIN

2. General. The Alabama-Coosa River system drains northeastern and east-central Alabama, northwestern Georgia, and a small portion of Tennessee. The drainage basin has a maximum length of about 330 miles, an average width of approximately 70 miles and a maximum width of about 125 miles. It covers a total of 22,800 square miles: 17,300 in Alabama; 5,400 in Georgia; and 100 in Tennessee.

3. The headwater streams rise in the Blue Ridge Mountains of Georgia and Tennessee and flow southwest, combining at Rome, Ga., to form the Coosa River. The confluence of the Coosa and Tallapoosa Rivers in central Alabama forms the Alabama River, which in turn unites with the Tombigbee River to form the Mobile River. The Mobile River flows south 45 miles, emptying into Mobile Bay, an estuary of the Gulf of Mexico. A general map of the basin is shown on chart 1; profiles of the main stem and principal tributaries on charts 2 and 3; and a list of the main streams and tributaries with drainage areas and mileages at point of confluence in table 1, following paragraph 10.

4. Alabama River. The Alabama River is formed near Montgomery, Ala., and meanders through the Coastal Plain westerly for about 100 miles to Selma, Ala., and thence southwesterly 214 miles to its mouth near Calvert, Ala.

5. The flood plain is characterized by valleys varying in width from 1/2 mile to 8 miles, with an average width of approximately 3 miles. The valleys are formed by low hills which seldom attain an elevation of more than 500 feet. The river falls a total of 106 feet with an average slope of 0.34 foot per mile. At low stages, the effect of the tide in Mobile Bay is noticeable at the juncture of the Alabama and Tombigbee Rivers. At Montgomery (mile 297), the maximum recorded discharge of the Alabama River is 230,000 cfs; the minimum daily discharge, which is influenced by regulation from upstream dams, 2,420 cfs; and the mean discharge, 24,000 cfs. At Claiborne, Ala. (mile 76), the discharge station nearest its mouth, the maximum recorded discharge is 227,000 cfs; the minimum daily discharge, 5,380 cfs; and the moan discharge, 32,000 cfs. The estimated average annual runoff from the



ALABAMA-COOSA BASIN
RESERVOIR REGULATION MANUAL

GENERAL MAP

CORPS OF ENGINEERS, U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
MOBILE DISTRICT, MOBILE, ALA.

5 MAY, 1950 FILE NO. A-8-1-29

CHART [redacted] NO 1

CECW-P Engineer Regulation 1105-2-100	Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000	ER 1105-2-100 22 April 2000
	Planning PLANNING GUIDANCE NOTEBOOK	
	Distribution Restriction Statement Approved for public release; distribution is unlimited.	

APPENDIX C

Environmental Evaluation and Compliance

C-1. Introduction and Overview

a. Purpose. This appendix addresses the integration of environmental evaluation and compliance requirements, pursuant to national environmental statutes, applicable executive orders and other Federal planning requirements, into the planning of Civil Works water and related land resources comprehensive plans and implementation projects. (Note: Every effort has been made to eliminate all inconsistencies between the main body of the ER and the appendices. If any inconsistencies are found, the information in the main body of the ER will prevail over the one in the appendices. Please, notify CECW-PD immediately of any inconsistencies for correction.)

b. Overview. The nation is attuned to the many ways healthy ecosystems support the economy and provide for the public good. The Water Resources Planning Act, as amended (WRPA) (42 U.S.C. 1962a-2) and the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321-4347 guide the Civil Works planning process, serving to focus the critical evaluation of the cost of today's activities in terms of tomorrow's resources. In 1962, Congress recognized the need for coordinated planning related to the conservation, development, and utilization of water resources and, through the WRPA, required the establishment and use of principles, standards and procedures for the formulation and evaluation of water and related land resources projects. In 1969, by way of the NEPA, Congress recognized the profound impact of human activity on the interrelations of all components of the natural environment as well as the critical importance, to humans, of restoring and maintaining environmental quality. The Federal Government was charged with using all practicable means and measures in a manner calculated to foster and promote the general welfare, create and maintain conditions under which humans and nature can exist in productive harmony, and fulfill the social, economic and other requirements of present and future generations of Americans. Numerous other laws, regulations and Administration initiatives, have echoed this National environmental policy. Integrated, the implementing regulations for the WRPA and the NEPA provide an effective framework for the formulation and evaluation of water resources comprehensive plans and implementation projects, which is responsive to the challenge of sustainable development in our Nation and the world.

c. Federal Objectives. The Federal objective for water and related land resources planning was established in the Water Resource Council's *Economic and Environmental Principles for Water and Related Land Resources Implementation Studies* (Principles), and is further discussed in the *Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies* (Guidelines).

establishing the need for ocean disposal includes compliance with applicable environmental criteria of 40 CFR Part 227 relating to the effects of disposal, navigation, economic and industrial development, foreign and domestic commerce and availability of practicable alternatives to ocean disposal.

(3) In considering feasible ocean sites for the disposal of dredged material, the District Commander will utilize ocean sites designated by EPA to the maximum extent practical. Where no EPA designated site is available or where such sites are determined not to be feasible for use based on the NED Plan, the District Commander may select a suitable ocean disposal site or sites under authority of Section 103 of the MPRSA using procedures and outlined criteria in 40 CFR 228.4(e), 228.5 and 228.6. Appropriate NEPA documentation should be used to support site selections; preferably incorporating these considerations into the project NEPA document.

(4) Where ocean disposal is determined to be necessary, the District Commander will, to the fullest extent practicable, specify potential disposal sites in the feasibility report. The feasibility report must fully demonstrate that there are acceptable potential disposal sites which incorporate both economic and environmental considerations, within the zone of siting feasibility for the project. District commanders shall conduct and, to the fullest extent practicable, complete the Section 103 evaluation during feasibility planning when ocean dumping alternatives are being considered. Data developed in this manner will facilitate the comparison of alternative ocean disposal plans. If the Section 102 evaluation has not been completed for projects currently in preconstruction planning and engineering, it shall be completed as an integral part of the decisionmaking process for initiating or implementing the project.

(5) Dredged material will be evaluated to ensure that it is suitable for aquatic disposal. Evaluation, and any subsequent sediment testing that may be required, will be performed in accordance with USEPA/USACE "Evaluation of Dredged Material Proposed for Ocean Disposal (Testing Manual)" or USEPA/USACE "Evaluation of Dredged Material Proposed for Discharge in Inland and Near-Coastal Waters - Testing Manual".

l. Water Quality Standards.

(1) Standards. The District Commander shall consider applicable Federal, State and local effluent limitations, water quality standards and management practices, as part of the formulation of alternative plans in feasibility and preconstruction planning and engineering studies. (See E.0. 12088, 13 October 1978.)

(2) Streamflow Regulation. There are two categories of reservoir capacity for the regulation of streamflow, pursuant to Section 102(b)(1) of the Clean Water Act: (a) That which is associated with identifiable project outputs such as navigation, recreation, fish and wildlife or the

prevention of salt water intrusion, and (b) That which is associated with water quality control. The need for and value of storage for the regulation of streamflow for water quality control may be taken into account in a project only if so determined by the Administrator of EPA. Costs allocated to streamflow regulation for water quality control are nonreimbursable if the benefits of such regulation are widespread. (See Chapter 2, Section III regarding deletion or modification of reservoir storage for water quality purposes in accordance with Section 65, Public Law 93-251.)

m. Water Quality Enhancement Costs. Costs for water quality enhancement must be assigned to the appropriate project purposes and shared in the same percentages as the purposes to which the costs are assigned (See Section 103(d) of Public Law 99-662.)

n. Exclusions for Emergencies. District commanders shall meet the evaluation and coordination requirements related to the Sections 404 and 102 guidelines to the fullest extent practicable, unless they determine that the resulting delays will lead to unacceptable risks to health, life, or property or severe and unacceptable economic losses. To further reduce administrative burdens and to expedite meeting these requirements, the District Commander should establish procedures in cooperation with the appropriate Federal and State agencies as recommended in ER 500-1-1. Carrying out the directives of this paragraph is crucial, since compliance with Section 401(a) of the Clean Water Act cannot be waived by the Corps of Engineers. Currently, Section 14 emergency stream bank erosion is the only element of the Civil Works planning program subject to emergency procedures.

o. Non-Point Source Pollution Program. The Water Quality Act of 1987 (Section 319) requires that Federal assistance programs and development projects be consistent with State non point source (NPS) management programs, for those States which have such Environmental Protection Agency (EPA) approved programs. Federal agencies are required to assure that their programs and projects are consistent with those programs. To assist in this process, EPA has developed a "Nonpoint Source Guidance" document dated December 1987 (52 FR 47971).

p. Coastal Zone Management. Sections 307c(1) and (2) of the Coastal Zone Management Act require that each Federal agency conducting, supporting, or undertaking development activities that are in, or directly affect, the coastal zone of a state shall insure that the project is, to the maximum extent practicable, consistent with approved state management plans. Civil Works activities of the Corps of Engineers in the coastal zone fall within this classification.

q. National Estuary Program. In 1987, Congress amended the Clean Water Act formally establishing the National Estuary Program. The purpose of the Program is to identify nationally significant estuaries, protect and improve their water quality, and enhance their living resources. Section 320 of the Act allows a state's governor to nominate an estuary and convene a management conference to develop a Comprehensive Conservation and Management Plan

COMPREHENSIVE STUDY

ALABAMA-COOSA-TALLAPOOSA AND APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASINS

VOLUME I
PLAN OF STUDY
MAIN REPORT

Prepared By:

**THE
COMPREHENSIVE STUDY
TECHNICAL COORDINATION GROUP**

JANUARY 1992

IV. STUDY ELEMENTS

A. Introduction.

The study elements are grouped into three major categories reflecting the areas of emphasis. The categories are: Water Demand, Water Resources Availability and Comprehensive Management Strategy.

B. Water Demand.

This section of the Plan of Study presents study elements for the water demand portion of the Comprehensive Study. The purpose of the water demand section is to identify, describe and quantify all water demands within the basins. Water demands shall include both consumptive and non-consumptive uses of groundwater and surface water, including reservoirs. The water demand elements described in this section are as follows.

- o <u>Agriculture Demand</u>: Describe and quantify the existing and projected agricultural demand on the water resources within the ACT and ACF River Basins.

- o <u>Apalachicola River and Bay</u>: Improve knowledge of the bay and riverine system in order to describe: (1) the freshwater and nutrient requirements of Apalachicola River and Bay necessary to maintain historic productivity and diversity in the system; and (2) the linkage and correlation between the riverine conditions and estuarine productivity.

- o <u>Environment</u>: Determine significant, water related environmental needs of the basins and describe environmental effects caused by changes in the existing water management system.

- o <u>Hydropower Demand</u>: Describe and quantify the existing capacity and operational procedures for hydroelectric power facilities within the ACT and ACF Basins.

- o <u>Industrial Demand</u>: Describe and quantify the existing industrial water demand within the ACT and ACF Basins and project industrial water needs through the planning period.

- o <u>Municipal Water Demand</u>: Describe and quantify the existing municipal water demand within the basins and project municipal water demand through the planning period. Municipal demand includes all uses with the exception of industrial, agricultural and instream uses.

Curtis Flakes

DISPOSITION FORM
For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
CESAM-PD-FA (1105)	Southeast Drought Action Report

TO SEE DISTRIBUTION FROM PD DATE 7 September 1988 CMT 1

1. We are currently beginning to develop suggested actions which may be taken to cope with future drought for the subject report. As previously discussed with your supervisor, we have decided to select several teams to brainstorm various ideas we have received to date. The purpose of this exercise will be to think out the ramifications of the proposed idea and to develop a brief description, in bullet form, of the views of the teams. The teams will meet at their convenience for a few hours per day between two and four times this week and next week. The facilitator for each team, designated with an *, will be in contact with you to make arrangements. Don Chatelain, who is the South Atlantic Division Coordinator for this effort, will further brief each team at their first meeting, upon request.

2. The teams and their subjects for discussion are listed below.

TEAM	DISCUSSION SUBJECTS
Team A - Ken Turner* Claudia Rogers Eric Nelson Gress Hickman	• Allow use of "drought" control benefits in project formulation. • Make M&I water supply and/or drought control high priority outputs. • Eliminate the least costly alternative method of establishing water supply benefits in drought-stricken areas. • Subsidized Drought Insurance for Agriculture as well as industry and communities. • Consider placing selected Government-funded research and development on drought control under the Corps. • Establish new generic legislation that makes single purpose water supply and/or hydropower projects a primary mission of the Corps.
Team B Amy Bridges* Tommy Pierce Jack Cunningham Bo Hanna	• Reevaluate buffer "taking line" policy on multi-purpose projects to determine if a more appropriate acquisition policy would be in order.

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- Reevaluate the current "PMF" and emergency spillway elevation criteria to determine if these requirements can be relaxed--especially in the case of small upstream impoundments in rural areas.
- Allow reallocations to water supply from multi-purpose projects to exceed the standard 15% or 50,000 acre-feet.
- Suspend or reduce marina operators concessionaire payments during times of severe drought.
- Relax rules for emergency withdrawal from multi-purpose projects during droughts.
- Give Corps (or another Federal agency) authority to require private power facilities to cut back on their water use during a declared drought.
- Authorize the Corps to construct joint projects with private power companies and municipal governments.

<u>Team C</u> - Pete Woolsey*
Howard Whittington
Greg Miller
Steve Van Fleet (or alternate from EN-F)

- Create a new continuing authorities program with monetary limits similar to the Section 205 program and/or the Section 14 program to authorize the Corps to undertake small-scale drought control/water supply projects.
- Modify P.L. 84-99 authority to allow the Corps to take a more active role after a drought emergency disaster proclamation has been made.
- Authority to undertake drought-related engineering studies such as: low flow frequency analysis, low flow hydrological and hydraulic modeling, precipitation frequency analysis, etc.
- Authorize the Corps to construct emergency instream weirs, temporary dams, etc. to protect necessary water supply pools and for protection against advancing salt water into fresh water supplies.
- Authorize/fund the Soil Conservation Service to undertake the comprehensive construction of farm ponds and small upstream impoundments.

- Authorize/fund USGS to conduct a comprehensive groundwater monitoring and modeling program.

Team D - Ken Sims*
Harold Doyal
Bob Allen
Cheryl Ulrich
Gene Russell

- Increase monetary limits of Section 22 authority or provide other legislation enabling the Corps to assist states and municipalities in drought management.
- Establish new generic legislation that makes drought control a primary mission of the Corps.
- Designate the Corps as the lead agency and clearinghouse for all drought-related matters.
- Cooperate with states and other local entities to establish basin-wide drought contingency plans.
- Periodically issue public information brochures on water conservation.
- Authority to undertake comprehensive drought-related studies on various conservation and water supply augmentation measures, demand reduction and impact minimization actions.
- Authorize and fund Section 216 type reallocation reports and "308" type basin reports to develop comprehensive basin reports in the southeast.

Team E - Matt Laws*
George Atkins
Sid Bufkin
Ed Burkett
Jim Baxter
Joe Paine
Ashford Kettler

- New Ideas

Team F - Curtis Flakes*
Susan Rees
Mike Eubanks
Brian Peck
Dewayne Imsand
Dottie Gibbens
Henry Pope

- Environmental Considerations

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SUBJECT: Southeast Drought Action Report

Team G	Roger Burke*	• Critique all ideas
	Jamie Hildreth	• New ideas
	N. D. McClure	• Any others they choose
	Larry Green	

3. A list of the overall subjects are attached for your information.

4. The team "report" is due on 16 September 1988. The charge number for all work on this effort is CBK01 07530 00013. If you have any questions, please contact Don Chatelain at ext. 2693.

Atch

for N. D. McCLURE
Chief, Planning Division

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EN-YH/Doyal
EN-YR/Hanna
OP-ON/Baxter

SOUTHEAST DROUGHT ACTION PLAN
SUGGESTED ACTIONS WHICH MAY BE TAKEN

POSSIBLE POLICY MODIFICATIONS

- Allow use of "drought" control benefits in project formulation.
- Make M&I water supply and/or drought control high priority outputs.
- Eliminate the least costly alternative method of establishing water supply benefits in drought-stricken areas.
- Reevaluate buffer "taking line" policy on multipurpose projects to determine if a more appropriate acquisition policy would be in order.
- Reevaluate the current "PMF" and emergency spillway elevation criteria to determine if these requirements can be relaxed—especially in the case of small upstream impoundments in rural areas.
- Allow reallocations to water supply from multipurpose projects to exceed the standard 15% or 50,000 acre-feet.
- Suspend or reduce marina operators concessionaire payments during times of severe drought.
- Relax rules for emergency withdrawal from multipurpose projects during droughts.
- Allow temporary reallocation of water supply based on some reduced rates during a declared drought period.

POSSIBLE LEGAL MODIFICATIONS

- Subsidized Drought Insurance for Agriculture as well as industry and communities.
- Increase monetary limits of Section 22 authority or provide other legislation enabling the Corps to Assist states and municipalities in Drought Management.
- Create a new continuing authorities program with monetary limits similar to the Section 205 program and/or the Section 14 program to authorize the Corps to undertake small-scale drought control/water supply projects.

- Modify P.L. 84-99 authority to allow the Corps to take a more active role after a drought emergency disaster proclamation has been made.
- Establish new generic legislation that makes drought control a primary mission of the Corps.
  - Under that authority include the following:
    - Consider placing selected Government-funded research and development on drought control under the Corps.
    - Designate the Corps as the lead agency and clearinghouse for all drought-related matters.
    - Cooperate with states and other local entities to establish basin-wide drought contingency plans.
    - Periodically issue public information brochures on water conservation.
    - Authority to undertake drought-related engineering studies such as: low flow frequency analysis, low flow hydrological and hydraulic modeling, precipitation frequency analysis, etc.
    - Authority to undertake comprehensive drought related studies on various conservation and water supply augmentation measures, demand reduction and impact minimization actions.
- Establish new generic legislation that makes single purpose water supply and/or hydropower projects a primary mission of the Corps.
- Authorize and fund Section 216 type reallocation reports and "308" type basin reports to develop comprehensive basin reports in the southeast.
- Reactivate/fund most promising multipurpose projects in the drought-stricken area.
- Passage of a Job Bill type program to make immediate improvements.
- Give Corps (or another Federal agency) authority to require private power facilities to cut back on their water use during a declared drought.
- Authorize the Corps to construct emergency instream weirs, temporary dams, etc. to protect necessary water supply pools and for protection against advancing salt water into fresh water supplies.

- Authorize/fund the Soil Conservation Service to undertake the comprehensive construction of farm ponds and small upstream impoundments.
- Authorize/fund USGS to conduct a comprehensive groundwater monitoring and modeling program.
- Authorize the Corps to construct joint projects with private power companies and municipal governments.

LOCAL PROJECTS

- Relocate Bushy Park intake canal (salinity) in South Carolina.
- Surface water supply from Savannah River to Hilton Head in South Carolina.
- Crooked Creek/Bennettsville, South Carolina, water supply/flood control reservoir.
- Construct a water supply/hydropower facility on Holley Creek near Dalton, Georgia.
- Consider constructing a water supply project on Pumpkinvine Creek in Georgia.

TEAM F ENVIRONMENTAL CONSIDERATIONS

CONTRIBUTORS: EUBANKS, FINDLEY, IMSAND, REES

IMPACT ASSESSMENT OF DROUGHT EFFECTS:

The following items are intended to provide information necessary to allow for improved methods of evaluating the impacts related to droughts. This information will enable more detailed knowledge of expected future impacts and appropriate counter measures.

- Conduct basin-wide analyses of water quality impacts for various drought intensities.
- Analyze frequency and duration of drought-caused impacts.
- Institute water quality sampling and analysis to improve predictive capabilities of drought impacts.
- Evaluate impacts on aquatic and terrestrial habitat for various drought intensities to improve predictive impact capabilities.
- Develop predictive capabilities of aquatic and terrestrial habitat losses, water quality impacts and determine ecological impacts.
- Enhance predictive capabilities relative to salt water intrusion.
- Develop water management techniques to reduce adverse salinity increases.
- Investigate capability for interbasin water transfer for water quality improvements.

VEGETATIVE AND STRUCTURAL METHODS OF EROSION REDUCTION:

The excessively low water levels associated with drought conditions provide an opportunity for bank and instream erosion protection.

- Define methods to reduce adverse erosion-caused impacts to water quality.
- Define areas of serious loss of bank and instream habitat.
- Develop environmental techniques to assist in reducing dredging impacts and costs in riverine and estuarine habitats.

HABITAT PRESERVATION, IMPROVEMENT, AND ESTABLISHMENT:

The items listed below have been identified to preserve, improve existing habitats, and to establish others during drought conditions.

- o Establish a plan for the management of wetlands to improve their ecological value.
- o Accelerate noxious aquatic plant control during droughts.
- o Institute methods for the reduction of excessive populations of rough fish.
- o Implement methods for the improvement of waterfowl habitat.
- o Initiate construction of fishery habitat.
- o Intensify fire-control measures in drought-stricken areas.

STREAMLINING COMPLIANCE PROCESS

Contributor: Flakes

The environmental process for Federal projects involves conformance with more than twenty-five Federal statutes and numerous applicable state and local laws. The following recommendations are intended to expedite the process for Drought Control (DC) Activities and, yet, facilitate compliance.

NEPA

o Prepare Generic EIS addressing impact of DC activities.

o Develop procedures for checklist environmental assessment for DC activities which may arise that were not included in Generic EIS.

o Conduct evaluations and coordination required by other applicable standards concurrently with Generic EIS.

o Develop categorical exclusion for DC activities that would not have a significant impact on the environment when considered individually and cumulatively.

o Modify 33CFR Part 230.8 to include activities contained in DC authority as an emergency action.

Coastal Zone Management Act and and Clean Water Act

o Develop procedures so that CZM and WQC procedures are addressed during Generic EIS coordination with the certifications issued for an indefinite period of time unless changes require reevaluation.

o Develop general nationwide and regional permits to address DC activities.

o Develop checklist 404(b)(1) procedures.

Expedite Coordination

o Develop national policy on informal coordination and set forth practice and procedures to implement policy.

o Develop advance agreements with state and Federal agencies on expediting coordination.

o Develop joint practices and procedures utilizing Environmental Resources and Information Management personnel to expedite coordination.

Southeast Drought Action Report

Recreational Aspects of Drought Management

1 - Utilize low water conditions for maintenance and repair of shoreline facilities.

2 - Extend boat launching ramps to allow for use during periods of extreme low water.

3 - During drought periods, close the more heavily used recreational areas and divert use to less popular areas. Such areas will have received less user impact and will be more tolerant to use during drought periods. This will also offer an opportunity to repair and upgrade facilities at the normally more heavily used sites.

4 Design boat dock to be movable into deeper water as the need occurs.

Drought Action Report

Cultural Resources

During drought conditions cultural resources surveys of areas that are normally inundated can be conducted.

Stabilization/preservation measures can be implemented at archeological sites that are subject to erosion by pool level fluctuation or streambank erosion. These measures could include planting vegetation which is compatible with other environmental enhancement.

PD-EC / FLAKES

DISPOSITION FORM
For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
CESAM-PD-FA (1105)	Southeast Drought Action Report, Concluding Section

TO SEE DISTRIBUTION FROM PD-FA DATE 20 Sep 88 CMT 1

1. Attached is an uncoordinated copy of the concluding section of the subject report for your review. I am forwarding this section in advance of the final draft report because of the controversial nature of many of the suggestions which have been made. This section is a smorgasbord of all the ideas I have heard. This document will likely have to be substantially revised and toned down in the final report. Your name is on this list because you individually, your employees/team members were instrumental in generating some of these ideas.

2. This document is concurrently being reviewed by OCE, SAD, and the Savannah, Jacksonville, Charleston and Wilmington Districts. There is an on-board review by representatives of all these offices and Mobile tentatively scheduled for Tuesday, 27 September 1988. I would appreciate any comments you might have in that timeframe. It would be especially helpful if I could receive your comments by COB this Friday, 23 September 1988. This would give me time to absorb the comments over the weekend so that I could go to Atlanta with a Mobile District position.

3. The final draft of the report should be available for your review in early October. The scheduled completion for the final printed report is 28 October 1988.

4. If you have any questions or would like to discuss any of the issues in the subject section, please contact me at extension 2693. Thanks.

Donald J Chatelain

DONALD J. CHATELAIN, P.E.
Chief, Eastern Basins Section
SAD Coordinator for the
Southeast Drought Action Report

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ACTIONS WHICH COULD BE TAKEN UNDER THE EXISTING AUTHORITIES OF THE CORPS OF ENGINEERS

Introduction. The Corps of Engineers has responded to the drought of the 1980's to the maximum extent possible under its traditional Congressionally authorized role in water resources. Perhaps the Corps' biggest single contribution was the modified operation of the multi-purpose projects in the region. This operational scheme preserved water and provided for water supply and water quality needs throughout the southeastern region. This action also involved a massive coordination effort and public involvement program. Although the Corps' role in drought-related activities is limited, there are numerous actions which could be taken under existing authority to better prepare us for drought in the future. This is especially true if one presumes that drought management, water supply or water conservation becomes a primary mission of the Corps. The following paragraphs describe what should be done internally within the Corps from that perspective.

Actions Requiring General Policy Change. It is recommended that Corps of Engineers general policy be modified to incorporate the following drought-related activities:

a. Require new recreation facilities to be constructed to be usable in droughts.

b. Develop a nationwide public relations program promoting water conservation and the Corps role in drought activities.

c. Allow harvesting of hay on some Corps-owned lands.

d. Expand operational authority on dredging and marking navigation hazards.

e. Adjust rental fees for marina operators on Corps lakes. They pay a rental fee which is a ratio of gross income to fixed assets. When business is down, the rental fees are less. There are, however, additional expenses in moving and repairing docks which are not considered in the rental payment.

f. Relax restriction on purchasing of items needed for public safety during drought (cables, signs, buoys, etc.)

g. Curtail harvesting of forested areas on government lands so that more rainwater can be retained and ultimately recharge groundwater aquifers.

h. Add bulb turbines or small hydros to better control water releases.

i. Relax strict interpretation of procurement regulations during drought to allow the purchase of large amounts of concrete. The concrete would be used primarily to extend boat ramps during drought.

j. Allow a variance from the Corps' Shoreline Management Plan around lakes to allow individuals to install a temporary mooring buoy.

Actions Requiring Changes in Formulation Policy. There are several existing Corps of Engineers policies which could be modified or clarified to more fully recognize drought control/water supply as a national priority. These are outlined in the following paragraphs.

a. Develop Guidelines for Use of "Drought Control Benefits." Although such benefits could probably be considered within the framework of existing regulations, such benefits are rarely used. The primary reason for this is the extreme difficulty in quantifying such benefits. Thus, field operating offices have not been able to develop a methodology which would be acceptable to the economic community. It is suggested that consideration be given to developing guidelines for the use of such benefits. Drought control/water supply could be thought of in the same conceptional terms as hydropower, i.e., energy and capacity benefits. Why not use capacity and quantity of water in analyzing drought control benefits? It may well be that a surrogate value for this benefit can be developed. This value could be based on parameters such as severity of drought, economic impacts and an area's potential for future growth. Examples of other surrogate values used in the Corps are: "Appalachia" type benefits; the ability to pay analysis for Local Cooperation Agreements; and the increased relocation cost required to provide decent, safe and sanitary housing and environmental mitigation which both presume that the cost of such work is equal to the benefits.

b. Allow Use of Water Quality Benefits. Conservation storage is used to maintain instream flows thereby helping downstream wastewater plants and industries to maintain minimum water quality standards. Without these reservoir releases, the downstream discharges would require local industries to expend more resources to upgrade treatment facilities. Because the reservoirs reduce treatment costs and improve the downstream environment, especially during drought, water quality should be returned as a project purpose and as an economic benefit. If this policy is modified, guidelines and methodology for developing such benefits need to be developed.

c. Allow Use of Benefits for Prevention of Saltwater Intrusion. Benefits in this area are somewhat interrelated to drought control and water supply benefits. As mentioned in the Drought Control Benefits paragraph above, there has been little attempt to quantify these benefits in the past. With the new emphasis on drought control, guidelines and methodologies need to be established for estimating these types of benefits.

d. Use of Trauma Benefits. In the past, several Districts have sought approval for methodologies they developed for trauma benefits on flood control projects. All of these attempts have been aborted at the Washington level. These type benefits are mentioned here to make two points. First, there is an element of human hardship and, in cases, established health impacts which are not considered in traditional economic evaluations within the Corps. The second point is that trauma benefits are in some ways more quantifiable than drought or saltwater intrusion prevention benefits, yet the methodologies for these benefits have not been accepted. If this general thinking prevails, any drought control mission will be unfairly penalized.

e. Designate Water Supply and Drought Control High Priority Outputs. Such a designation would place water supply and drought control at the same level of emphasis as flood control and navigation.

f. Consider a Variation in Formulation Policy in Drought-Stricken Areas. Current policy specifies that when estimating the value of water supply in a project, the most likely/least costly alternative should be used to develop that value. That is a prudent rule in most situations; however, this rule can discourage the development of water supply projects in certain areas, thereby being a detriment to regional drought planning. For example, the most likely/least costly alternative to water supply in northern Georgia many times ends up being the purchase of water from an existing Corps lake. Thus, the construction of a water supply project is penalized because there happens to be another project in this drought-stricken area. This reinforces the proposition that the true value of drought prevention is not being considered in economic evaluations. It is suggested that the value of water in a project be established on an alternate benefit basis such as the least costly means of obtaining water from a source other than an existing lake in a drought-stricken area. In this manner, we could establish "regional" systems of water supply and drought control as an overall goal. This would minimize the level of contingency storage required to meet peak and drought demand levels in local water supply systems. Regional systems offer greater allocation flexibility during emergency situations. Also, water quality monitoring and testing costs are reduced due to economies of scale.

f. Real Estate Acquisition Policy. It is suggested that existing real estate acquisition policy be modified to apply the "fee acquisition policy" throughout the project regardless of remoteness of an area. This would provide a fee buffer completely surrounding the impoundment, and as a result, should lessen pressures from private recreational developers and individual property owners. Also, the development in the buffer area could be limited, by regulation or policy, to Corps or Corps-sponsored recreational development. The elevation used to set the boundaries for recreational use should be established prior to project construction.

h. Modifications of Dam Design Criteria for Small Dams. Floods less than the Probable Maximum Flood could be used as Spillway Design Floods for small dams impounding a few thousand acre-feet of storage and in an area where hazard to life and property would be relatively small in the event of a failure. The occurrence of floods that would cause overtopping should be relatively infrequent, and if the overtopping caused embankment failure, the rate of failure should be gradual or the amount of water impounded should never be large enough to cause a major flood wave. If potential flooding is an overriding consideration, permanent flood easements could be purchased. EC 1110-2-27 and EM 1110-2-1101 already have some spillway design criteria for small dams. Perhaps these documents could be modified to include criteria for small water supply or drought control structures. There should be a meeting of hydrology and hydraulic specialists to discuss the criteria and ramifications of the criteria and to recommend a Corps policy in regard to this type of structure.

<u>Other Actions</u>. If drought control were made a primary mission of the Corps, there are several changes that could be made at the Field Operating Offices. Among these are: Expedite Section 10 and 404 permits

in drought-related matters. Prepare Generic EIS' addressing the impacts of routine/minor drought management activities. Develop a categorical exclusion for drought management activities that will not have a significant impact on the environment when considered individually and cumulatively. Expedite environmental coordination through advance agreements with states and agencies.

Summary. If drought control becomes a primary mission of the Corps, we need to reevaluate our existing policy. This new focus dictates that we consider modifying the rules on the use of our facilities at our multi-purpose projects. We also need to take a proactive role in public relations regarding drought. Most importantly, we need to carefully rethink our existing project formulation rules so that drought control will be given equal consideration to other missions of the Corps.

ACTIONS REQUIRING MODIFICATION
TO LEGISLATION, STUDY AUTHORIZATION, OR FUNDING

Introduction. Once a major drought has occurred, the general public's natural reaction is "what can we do immediately or in the near term?" Unfortunately, outside of conserving the water supplies that are available, there is little that can be done at that point. During and immediately after other national disasters such as floods and hurricanes, there are several Federal agencies which have statutory authority to respond to the emergency. During drought, for the most part, those authorities do not exist. It is true that the nature of drought impacts is not easily fixable in the near term. However, there are a few things that can be done. Similarly, the Federal government has undertaken major flood control and hurricane protection projects over the long term, yet there is no authority to undertake long-term drought control measures. The purpose of this section of the report is to identify what measures can be taken both in the near- and long-term.

A discussion of drought management must include water management and conservation, since these subjects are so integrally related. The first step necessary to quantify the future impacts of drought, is to assess water availability and demand (water budget). Once this baseline is established, the water uses and availability for various purposes need to be projected into the future. Then, the shortfalls of water availability for the region can be established. To mitigate these shortfalls, consideration should be given to implementing various water conservation measures and changes in water management. Beyond this, the most efficient water augmentation measures must be identified. Only when all of this information is available as a foundation, can one reasonably assess the impact of drought through time and take appropriate actions to limit the impacts of drought. The balance of this section outlines a framework for a plan of action to develop the necessary assessments of water resources, conservation measures, drought management, water supply augmentation measures, and drought contingency actions.

Assessment. This report is a "quick" assessment of the water resources in the southeast and the impact of drought in the region. However, a much more comprehensive assessment needs to be undertaken before the best approach to mitigating drought can be determined. Further, this assessment needs to be made on a broad regional and national basis in order to effectively deal with the problem. Among the types of assessments which need to be made are water availability, water use, water resources infrastructure, institutional activities and technical evaluations of drought.

a. Water Availability. To assess the availability of water in the region, rainfall and streamflow information has to be evaluated; potential changes in operation of existing reservoir projects must be considered; and groundwater data need to be collected. Data on rainfall and streamflow is plentiful; however, there may be a need to establish more gaging stations and/or increase monitoring in some areas. The potential changes in reservoir operations is a complex subject. Consideration must be given to all purposes--flood control, hydropower production, navigation, water supply, recreation, water quality, and fish and wildlife. Thus, such a determination will have to be made in a comprehensive reallocation study for the various projects. There is also a serious lack of quantifiable water availability information in some aquifers in the southeast. The United States Geological Survey (USGS) needs to develop three-dimensional models and expand their groundwater monitoring network in many areas so that groundwater reserves can be reliably inventoried. The USGS also needs to continue to study the statistical nature of drought in areas such as reoccurence intervals and durations.

b. Water Use. The expected water uses in the future need to be determined for various purposes such as agriculture, municipal, commercial and industrial. When evaluating these uses, consideration also needs to be given to conservation practices expected in the future.

c. Water Resources Infrastructure. The capability of the water resources infrastructure to deliver water for consumptive use is another important consideration. This effort would include an assessment of treatment plant capability, available distribution systems, pumping capacities, etc.

d. Institutional Activities. A review of local and state government activities in areas such as water laws, permitting process, monitoring, etc. is also an important part of the overall assessment.

e. Engineering/Economic/Environmental Evaluations of Drought. In order to measure the impact of drought on the water budget, a series of drought-related engineering investigations need to be conducted. These evaluations include: low flow frequency analysis, low flow hydrological and hydraulic modeling, precipitation frequency analysis, tree ring evaluations, potential changes in weather from phenomena such as the "greenhouse effect", etc. Economic studies will be required to measure the economic impact of drought. This information will be needed to efficiently formulate future water management and augmentation measures. Environmental studies need to be conducted to measure the impact of drought on water quality, saltwater intrusion, and on aquatic and terrestrial habitats. This information will be used to enhance the predictive capability of drought impacts on the environment.

ASSESSMENT - POTENTIAL MEANS OF ACCOMPLISHMENT
(OPTIONS)

a. Leave the responsibility of assessments with state and local governments.

b. Furnish technical assistance to local and state governments at their request. There is currently existing authority to furnish this assistance to states; however, the amount is limited to $200,000 per state per year under Section 22 of the Water Resources Development Act of 1974, P.L. 93-251. This monetary limit could be increased.

c. Establish generic legislation allowing the Corps to participate in joint local/Federal water management activities with appropriate cost sharing.

d. Authorize the Corps to conduct a broad regional assessment of water resources in the southeast at total Federal expense.

e. Either authorize joint Corps-USGS or an independent USGS study to obtain data and study drought-related phenomena, especially in the area of groundwater.

(SUGGESTED ACTION)

A cooperative effort between local and Federal government with the Federal sector paying 100% of its activities in data collection, engineering investigations, economic evaluations, water use studies and overall report analysis. If this action is selected alone, it is suggested that it be accomplished under the authority of Section 308 of the River and Harbor Act of 1927, P.L. 560. This method of implementation is suggested because of the broad regional scope of the water assessment. The cost sharing is suggested because such an assessment is felt to be beyond the capability of local governments. Further, this effort is considered to be regional in nature and thus is in the national interest.

Conservation. The first logical step towards mitigating the impacts of water shortages is through conservation. A regional evaluation of water conservation measures is needed to identify the various opportunities and constraints. It should be mentioned that several agencies have undertaken these type studies in the past, including the Corps Institute of Water Resources. Nevertheless, a new emphasis or focus on drought management calls for a need to reevaluate those efforts. These opportunities and constraints fall in the following broad categories: stricter controls on existing use, future development guidance system, reducing high consumption rates, education and promotions, and research and development.

a. Stricter Controls on Existing Use. In several areas of the southeast, there are loose controls on the use of water. In some municipalities, individual water consumption is not metered. In some states, there are major withdrawals of water made by industry and agriculture which are not permitted. These situations present two problems--the consumption increases sharply without controls and the overall demand and water use become difficult to define, thus complicating planning for the future.

b. Future Development Guidance System. Municipalities need to plan future development in consonance with future water availability. This can be accomplished by land use restrictions, zoning, conversions in land use and by tying future development to expansions in water management infrastructure.

c. Reducing High Consumption Rates. The potential for reducing consumption rates is an area which has received considerable attention--especially during times of drought. Residential consumption can be reduced by repairing leaks, metering, efficiency toilets and showers. In fact, toilet flushing represents 45% of total in-house use. The installation of an efficiency toilet could reduce that amount by 50%. Commercial and industrial consumption can be reduced by a variety of means. One promising means is through water reuse--the use of untreated or saline water in water closets for toilet flushing in office buildings or for industrial cooling water. The greatest potential for reducing consumption rates is in agriculture--especially irrigation. Irrigation accounts for 83 percent of the total consumption of water in the United States. Because of this, there is a tremendous potential for conservation by improving distribution systems and methods of watering, i.e., flooding of fields versus sprinkling. A great deal of irrigation consumption is in the 17 western states; however, the percentage in the southeast is significant. Exactly how much of the consumption in the southeast is contributed to irrigation is unknown, since some of the withdrawals are not permitted. This information is needed to assess the overall water picture as well as the potential for conservation.

Several municipalities have reduced consumption rates in the southeast through economic incentives during droughts. These economic incentives ranged from establishing higher water rates for excess use of water to fines for violating certain water restrictions. Other economic incentives which could be applied during non-drought periods are tax incentives or local requirements that water-efficient appliances and processes be used.

d. Education and Promotion. A national promotion and education program on water conservation may also be beneficial. Among the types of programs which could be applied are: a national PR campaign involving the President or other well-known individuals, establishing a water conservation week, or making water conservation a required topic in our schools.

e. Research and Development. There is a great deal of research and development on water conservation in the United States. There appears to be a need to assess the overall effort on conservation, drought and water conservation. This assessment could reveal a need to consolidate some of these efforts or to redirect or establish new research and development efforts in promising areas.

CONSERVATION - POTENTIAL MEANS OF ACCOMPLISHMENT
(OPTIONS)

a. Leave the responsibilities of conservation with state and local governments.

b. Generic legislation authorizing the Corps to participate with non-Federal interest in an advisory role in water conservation with appropriate cost sharing.

c. Authorize the Corps to undertake a regional or national conservation study at Federal expense.

(SUGGESTED ACTION)

Under the umbrella of an authorization such as the Section 308 authority suggested in the discussion on "Assessment", jointly evaluate water conservation with local and state governments. Funding would remain 100% Federal for identifying broad-scale regional or national studies and evaluations. Cost sharing for specific application studies within municipalities are suggested to be 50-50. Physical construction/ installation of conservation measures would be 100% local. This action would require new water conservation/drought management legislation or an amendment to Section 308.

Water Supply Augmentation Measures. There are a variety of means of augmenting existing supplies of water. In order to optimize such a development, consideration must be given to the following actions.

a. Construction of Small Upstream Impoundments. The Soil Conservation Service (SCS) has constructed numerous such projects through the years. The advantages of these type of structures are their economical construction cost and minimal environmental impacts. The disadvantages of these structures are their relatively small size and rural locations. Their potential for providing supplementary water for agriculture and small communities is high. To emphasize the potential of these projects, a 1972 report from SCS was selected as an example. That report recommended the construction of 44 small upstream impoundments in Alabama. The aggregate storage capacity was 3,750,000 acre-feet with a sustained yield of 3.5 billion gallons per day. This storage capacity exceeds that of the largest multi-purpose impoundment in the southeast.

b. Construction of Single-Purpose Impoundments. Single-purpose water supply and/or drought control structures are an integral part of drought control. It should be emphasized that many very promising single-purpose projects have been overlooked in previous studies because of existing laws. The policy implementing current law specifies that a minimum of 10% of the project benefits must be for navigation or flood control, regardless of the overall benefit/cost ratio. This has prevented the creation of water supply storage. It has caused Field Operating Offices to study multi-purpose impoundments in lieu of water supply projects regardless of local needs.

c. Construction of Multipurpose Impoundments. As demonstrated by the existing multipurpose impoundments in the southeast, they are an invaluable asset to the economic prosperity of the region. For example, Leonard Ledbetter, the Commissioner of the Department of Natural Resources (DNR) in Georgia, has stated that there would be a water crisis in Atlanta if it were not for nearby Lakes Allatoona and Lanier. To demonstrate this, the Georgia DNR estimates that metro Atlanta withdraws approximately 350 MGD from Lake Lanier and the Chattahoochee River. If Lake Lanier had not been constructed, the amount of water which would have been available from the river in July 1988 is estimated to be between 100 and 150 MGD, far less than the water supply needs.

d. Recharging Groundwater Supplies. Consideration also needs to be given to recharging groundwater supplies by retaining water on the ground through construction of dams or dikes or pumping surface waters through boreholes, wells, mineshafts, etc. This would help to recharge aquifers depleted by years of municipal and industrial well pumping. Many of the Corps projects are near the Fall Line where much of the coastal plain aquifer receives recharge. The benefits may be determined from the predicted costs avoided, such as drilling deeper wells, energy costs due to drawing from deep groundwater profiles, and an improvement in water quality (deeper aquifers may contain more minerals requiring removal, such as iron, manganese, calcium, magnesium, sulfate, sulfide, chloride, etc. Another possible benefit is prevention of saltwater intrusion. In addition to recharge, the Corps could investigate management of aquifers, for instance, by using the aquifer as an underground reservoir to be charged by pumping during wet periods so that the aquifer may be able to augment surface supplies during drought periods.

e. Interbasin Transfer. Although controversial and having legal implications, any regional water resources plan must consider interbasin and intrabasin transfers. This will require an extensive cooperative effort on a regional basis. The states of North Carolina and Virginia, for example, are considering revoking laws that prohibit interbasin transfers within a state.

f. Conjunctive Use. Conjunctive use refers to the coordinated use of both surface water and groundwater to meet regional water supply needs. Possible conjunctive use projects include: recharging aquifers from existing lakes during wet periods; diluting surface water with groundwater to reduce turbidity and therefore treatment cost; maintaining capability to treat surface or groundwater in combination by increasing groundwater use during periods of low flows and poor water quality; and alternately utilizing groundwater and surface water to balance supplies in both systems.

g. Operational Modification of Existing Projects. In evaluating the overall water needs of a region, changes in the operation of existing projects must be considered. Any changes which significantly impact the authorized purposes of the project will have to be thoroughly analyzed and eventually approved by the Congress. Among the untraditional ideas which need to be examined are: reallocating water from flood control to water supply as flood plains become less developed because of flood plain management laws, or considering purchasing structures in the flood plain to allow the reallocation. Other novel possibilities are constructing more locks and dams below major impoundments to reduce required releases for navigation; constructing small impoundments upstream of major reservoirs to provide local water supply and supplemental flows into major reservoirs during drought; providing "navigation windows" to minimize releases from major lakes, i.e., provide for navigation one week per month or every other month during drought; and negotiating with the Southeast Power Administration to reduce hydropower sales contracts thereby conserving water in the lakes.

h. Regional Systems. To combat the impacts of drought, one must think in broad regional terms. As in the conjunctive use systems with groundwater and surface water, the regional operation of surface water impoundments offers many possibilities to lessen the impacts of drought. The Dalton Lake, Georgia, project discussed in the section on "Future Outlook" has been selected to illustrate this point. Let us assume this project was being considered for construction as a hydropower and drought control/water supply project. The first prudent step would be to purchase an adequate buffer zone along the perimeter of the lake to prevent lakefront development which would abort the purpose of the project. During normal times, the water supply from this project could be used by the carpet industry in Dalton or to recharge groundwater. The project would also become the eleventh hydropower facility in the Alabama-Georgia hydropower marketing system. In this marketing system, power is sold in a common block. Thus, if there was less rain in Georgia than Alabama, the Alabama projects would generate an extra amount of energy to balance the impacts on lake levels throughout the area. If Dalton Lake was on line, that project could make up for a significant part of the energy which would normally be generated by other lakes having significant lakefront development. Since Dalton Lake's design was without recreation, the impacts there would be minor. To summarize the overall benefits, such a project would: provide water supply and hydropower during normal times; provide intermittent recreation; and help conserve the water supply in projects like Lake Lanier during drought through increased hydropower production. There would also be benefits to downstream navigation, water quality and fish and wildlife; however, the gain on the Dalton river system (Alabama-Coosa Rivers) would be offset by lower releases on other systems.

i. Saltwater/Brackish Water Conversion. The desalinization of water will become an alternative worthy of serious consideration as the costs of other alternatives approach that of desalinization over time. Desalinization of ocean water as a permanent water supply source would be an extreme measure. Desalinization of brackish surface or groundwater, on the other hand, can be practical during drought when surface supply is not otherwise available. Research and prototype operations in desalinization and wastewater reclamation should be encouraged. Brackish water conversion could be a promising element of a conjunctive use system in some areas.

j. Other Measures. There are numerous other water supply augmentation measures which can provide additional supplies on a localized basis. Among these are: the construction of farm ponds in rural areas; installing land treatment measures; the construction of canals interconnecting existing lakes to farm areas for use during drought; filling abandoned water wells during wet periods; pumping water from newly drilled wells to a depleting aquifer to maintain water levels or to combat saltwater intrusion; collecting discharges from artesian relief wells at Corps dams and transferring water to needed areas; and other experimental actions such as weather modification.

WATER SUPPLY AUGMENTATION MEASURES - SUGGESTED CHANGES
(OPTIONS)

a. Expand Corps of Engineers authority to construct all types of water supply augmentation measures with appropriate cost sharing.

b. Study projects at 100% Federal expense or under the flood control study cost sharing formula.

c. Construct projects at 100% Federal expense with agreements from local interests to adopt conservation measures in the future.

d. Automatically permit non-Federal payment for cost sharing over a period of 30 years in accordance with Section 103 of P.L. 99-662.

e. Provide funding for the Soil Conservation Service to undertake the construction of farm ponds and small upstream impoundments under the authority of their P.L. 566 authorization.

(SUGGESTED ACTION)

It is suggested that the Corps be authorized to construct all types of water augmentation structures subject to existing constraints such as environmental protection and economic feasibility. In the case of small upstream impoundments and other agricultural related measures, it is suggested that these projects be undertaken as a joint venture between the Corps and SCS. In severely drought-stricken regions, fund the reconnaissance report (25% of the effort) at 100% Federal and the balance at 75-25. Construction funding is suggested to be 75-25 for drought control with allowances of credit for promising conservation measures. Construction cost allocated to vendable purposes such as water supply and hydropower should be 100% non-Federal with reimbursement over a long period at a favorable interest rate. It is suggested that a 50- or 100-year period be adopted at the prevailing "social" interest rate (currently between 3 and 4 percent).

Drought Management Plans. The establishment of a drought management plan is an essential element in minimizing the impacts of drought. The main parts of this plan follow:

a. Establishment of a Drought Management Committee. The first step in any such plan is to assemble a drought management committee. These committees are normally focused along river basin boundaries and consist of representatives of affected interests. Their purpose is to collectively assess the situation, estimate potential impacts and ultimately make the tough choices on an operational plan. It should be mentioned that Drought Management Plans have been established, or are in the process of being established, in several river basins in the southeast. These plans need to be established in all river basins. An example of a successful interim drought management plan is the Apalachicola-Chattahoochee-Flint (ACF) River Basin in Alabama, Georgia and Florida. This Interstate Coordinating Committee (ICC) consists of a member from the Corps and each of the states. They are supported by a Technical Coordinating Group funded primarily through the Corps. This committee functioned well in the 1988 drought, minimizing impacts and keeping the public informed.

b. Establish a Definition of Drought. This seems to be a term of obvious understanding. It is not. Drought to different people means different things. The Palmer Index may be used in some areas; however, its universal application is limited because the index is based primarily on rainfall and temperature. Thus, in an area not totally dependent on rainfall (i.e., snow melt from other areas, reservoirs and groundwater supplies) it is not a good tool to manage drought. The Drought Management Committee needs to decide exactly what constitutes a drought in their specific area.

c. Develop a Drought Index. To be effective, any drought management activities need to be triggered by certain known and agreed upon events. In the ACF system, a mathematical formula considering numerous variables such as temperature, rainfall, inflows, lake levels, etc., has recently been developed for the Lake Lanier project. The results of this calculation is in the form of a scale from 1 to 10, with 10 being the worst drought on record. Currently, similar drought indexes are being developed on other projects in the ACF river system. The hard task now is for the ICC to agree to certain actions for different readings on the drought index scale.

d. Establish Priorities. The next decision which must be made is to establish priorities for the use of water during drought. Most communities can agree that drinking water is the number one priority. Then industrial water and water quality normally follow. The rest of the priorities are the really tough decisions—recreation, navigation, hydropower, and fish and wildlife. Let us not forget that flood control is one of the primary purposes of most of the multi-purpose Corps projects in the southeast, although it is normally not a matter of concern in times of drought.

e. **Activate the Plan.** The activation of the drought management plan involves the following actions: a broad and concentrated public involvement and awareness program; conservation measures such as rationing; reducing hydropower operations to conserve water; reducing releases for downstream navigation; modifying water utility operations; and taking other emergency measures such as economic incentives/penalties to conserve water.

DROUGHT MANAGEMENT PLANS - SUGGESTED MEANS OF ACCOMPLISHMENT

(OPTIONS)

a. Authorize or fund the preparation of individual drought management plans for all river basins with appropriate cost sharing.

b. Establish new generic legislation that makes drought control a primary mission of the Corps, with specified cost sharing.

c. Make drought management planning a local responsibility.

(SUGGESTED ACTION)

New generic legislation that makes drought control a primary mission of the Corps. Cost sharing would be as follows: Regional or national investigative efforts - 100% Federal. Participation in drought management committee at the expense of participants.

Drought Contingency Plans. In order to cope with drought, comprehensive drought contingency planning, purchasing and construction is needed. The best approach to accomplish this is through a continuing authorities program for drought similar to the Section 14 and 205 authorities in the flood control area. Currently, the Federal sectors' actions toward drought are mostly limited to reporting and impact minimization measures. Under this authority, the following activities could be undertaken: construction of weirs, cofferdams, channels, etc. at expected problem areas to maintain water levels at critical water intakes; inventory available equipment in southeast and program availability; purchase equipment necessary to supplement low water supplies during emergencies, i.e., pumps, pipe, hoses, vehicles, sandbags, fabric dam materials, water trucks, portable water purification plants, etc; purchase equipment and supplies necessary to make emergency provision on lakes and rivers, i.e., buoys, building materials, concrete, boots, channel markers, additional dredging capability, etc.; construct emergency canals, pipelines to be used in drought prior to their occurrence; undertake a shoreline protection plan to plant vegetation on exposed shores to reduce erosion; and a wildlife and aquatic habitat enhancement program by planting vegetation and wildlife food plots and reconstructing damaged oyster reefs, etc.

DROUGHT CONTINGENCY PLANS - SUGGESTED MEANS OF ACCOMPLISHMENT

(OPTIONS)

a. Leave drought contingency planning as a local responsibility.

b. Specific Congressional authorizations with appropriate cost sharing.

c. Establish a continuing authorities program with appropriate cost sharing.

(SUGGESTED ACTIONS)

Authorize the Corps to undertake a continuing authorities program for drought. Specific Congressional authorization would be required for major projects (over $15 million). Authorization of a Section 201 type authority for projects between $5 and $15 million. Such projects could be approved by Committee Resolution. Projects costing less than $5 million could be approved by ASA (CW). It is suggested that study cost be 100% Federal. Construction cost sharing for the program is suggested to be 75-25.

Actions During Drought. During drought, the Corps as well as other Federal agencies have very limited authority to take action. Actions which could be taken are: building weirs; constructing temporary dams; emergency withdrawals from existing impoundments with necessary associated work; diversions of waters; drilling new wells; providing additional storage or a reallocation of storage on a temporary basis with reimbursement during drought, etc.

ACTIONS DURING DROUGHT - SUGGESTED MEANS OF ACCOMPLISHMENT
(SUGGESTED ACTION)

Authorize Corps or the Federal Emergency Management Agency (FEMA) to take certain actions during drought under the authorities of P.L. 84-99 or a new authority at a 100% Federal cost.

Impact Minimization. Grant authority for some agencies in the Federal sector to provide drought insurance to business, industries and agriculture; establish a grant program on drought; low interest loans.

Jobs Bill. In the past, the Congress has appropriated funding for the immediate construction of public works projects in order to stimulate the economy. Such an action could also be taken for water supply and drought control.

Fallback Position. To this point, the suggested actions requiring legislation have been intentionally broad. At a very minimum, the Corps should be authorized to assist local governments in the development of water supply projects. The Corps of Engineers should be given authority to provide technical assistance to local governments contemplating constructing water supply projects. The Corps gets many requests from Congress to study river basins for a wide variety of water resource applications. Often the underlying reasons for these requests is for water supply, since flood damages are very low. The study then concentrates on analysis of multiple purpose reservoirs, thereby limiting the analysis on water supply and eventually water supply sites are altogether dropped from the analysis, when only minimal flood control benefits are identified. If the local governments need water supply studies, that is what the customer should receive, not studies of sites selected for multiple purpose potential instead of water supply potential.

There are other situations where the Federal government can assist communities in developing water supply projects. Because of financial constraints, municipalities often construct water supply projects that are undersized--not to the full storage or yield potential of the site. Once built, it is difficult and costly to increase storage when needed. The Corps should take the opportunity to aid in maximizing the full potential of any reservoir project. Where a municipality does not presently have the funds to build a large reservoir, low interest loans could be made available for prevention of drought emergencies. Low interest loans are available for recovery in declared disaster areas; why shouldn't they also be available for disaster prevention?

Reservoir site preservation is a concept which deserves discussion. As metropolitan areas expand, reservoir sites are developed for housing and business. The associated real estate escalation makes the sites too expensive to be used for water supply. If the rights can be secured years before these sites are selected for development, water supply costs could be reduced. The escalation of construction costs could not be stopped, but the higher escalation rate of real estate could be prevented. The local governments would suffer from the loss of tax base in the meantime; however, an overpurchasing of real estate would tend to offset that loss when these lands are eventually sold at higher prices. The sites could be purchased in fee, purchased as an easement, or be secured by a retainer, or by imposing land use restrictions. Unfortunately, many local communities cannot afford to take this type of action because of low cash flow. This is still another means by which the Federal government can take actions that will ultimately limit the impact of drought.

FALLBACK POSITION - SUGGESTED MEANS TO ACCOMPLISH

(SUGGESTED ACTION)

Modify Section 22 of the Water Resources Development Act of 1974, P.L. 93-251 to: Increase the monetary limits (currently $200,000 per state per year) to an overall sum of $50,000,000 to cover the entire United States; give ASA (CW) the authority to allocate these funds at his discretion; include all types of technical assistance from the Corps—planning, engineering and design expertise in the design of water impoundment facilities and the construction of emergency canals, distribution lines, etc. for water supply and drought control; and to include provisions for issuing low interest loans to municipalities (3 to 4%) over a 50-year period.

CONCLUSIONS

There is very little being done by the Federal sector in the area of drought control. In evaluating the overall drought control/water supply/water conservation (water management) issue, it becomes clear that there is not a piecemeal solution. Sure, individual projects or other efforts which will undoubtedly help the situation can be identified. But these actions will only solve a very small part of the problem in a specific area. Water management is a problem of national scope. It is clearly beyond the capability of local and state governments in most areas of the southeast, and for that matter, the nation. Further, the impacts of drought on the well-being of our people and the productivity of the nation dictate that the resolution of this problem is truly in the national interest. It is also a problem which will become even more critical in the future if a no-action posture is taken. For these reasons, the recommendations in this report call for a comprehensive program of water management. These recommendations cover the entire spectrum of water management—an assessment of our water resources situation, conservation, water supply augmentation measures and specific drought-related activities.

The Corps of Engineers is well suited to undertake this task. There are thirty-six Districts located throughout the United States which cover literally every river and stream in the country. Each of the Districts is aligned along river basin boundaries which will greatly facilitate the type of planning which will be required in water management. Further, each of these offices are staffed with planners, professional engineers, economists, environmentalists and numerous other physical and social scientists who have considerable experience in water reservoir development. The size of some of these staffs are impressive. The Mobile, Alabama, District in the southeast maintains a staff of 1,800 people, including over 200 registered professional engineers. In summary, the Corps is strategically arranged and professionally staffed to do the job well.

RECOMMENDATIONS

It is recommended that the Corps of Engineers be authorized to undertake drought-related activities as a primary mission. This generic authority should include:

a. Data collection, engineering investigations, economic evaluations, environmental evaluations, and water use studies necessary for an assessment of regional water supply needs and demands. These efforts would be 100% Federal.

b. Evaluation of regional and national water conservation measures. Broad-scale regional or national studies and evaluations would be 100% Federal. Cost sharing for specific application studies within municipalities would be 50-50. Physical construction/installation of water conservation measures would be 100% non-Federal.

c. Construction of a wide range of water augmentation measures, including single-purpose water supply and drought control structures. Feasibility studies would be 75% Federal and 25% non-Federal. The Reconnaissance Report would be 100% Federal. Construction cost sharing for drought control structures would be 75% Federal and 25% non-Federal. A credit to the non-Federal share is authorized for approved future water conservation measures which local interests agree to undertake. Construction costs allocated to vendable purposes such as water supply and hydropower production would be 100% non-Federal. Reimbursements for these purposes would be over a 50-year period at the prevailing social interest rate (currently 3 to 4%).

d. Preparation of drought management plans at 100% Federal cost.

e. A continuing authorities program to authorize the construction of drought contingency projects and the purchase of drought-related equipment and materials. Construction cost sharing is 75% Federal and 25% non-Federal. Study cost would be 100% Federal. Financial limitations are $15 million with Committee Resolution approval and $5 million with ASA (CW) approval.

f. Undertaking emergency work once the President has designated an area as a Drought Disaster Area. This work would include constructing weirs and temporary dams, emergency withdrawals from Corps impoundments, water hauling, construction of diversion structures and the drilling of new wells.

g. Authorize a joint effort between the U.S. Geological Survey and the Corps of Engineers to expand the existing water resources data collection, monitoring and analysis.

h. Authorize a joint effort between the Soil Conservation Service and the Corps of Engineers for the construction of small upstream impoundments and small rural water augmentation measures.

i. Provide technical and financial assistance to local and state governments in the construction of water supply impoundments and emergency canals, distribution lines, etc. for drought control and water supply. This assistance should be at 100% Federal cost. Technical assistance includes: planning, engineering and design of water impoundment facilities and the construction of emergency canals, distribution lines, etc. for water supply and drought control. Financial assistance includes: the issuance of low interest loans (3 to 4%) over a 50-year period for advance purchase of real estate and increasing the capacity of planned water supply and drought control impoundments.

R. M. BUNKER
Major General, USA
Commanding

CESAM-PD-EC [redacted] 8) (1105)
SUBJECT: Sou[redacted]n Report

THRU PD [redacted] FROM PD-E DATE 19 Sep 88 CMT 2
Flakes/tn/2408

TO PD-PA

PD-EC File

The information requested in CMT 1 is attached. Please note that this information is intended to:

a. Minimize the impact of droughts on the environment.

b. Streamline the compliance process.

c. Explore new opportunities provided by drought-related activities.

[redacted]

Atch

HUGH A. McCLELLAN
Chief, Environment and
Resources Branch

PD-EC/Flakes
PD-EC/Mallory
PD-EI
PD-ER
PD-E/McClellan

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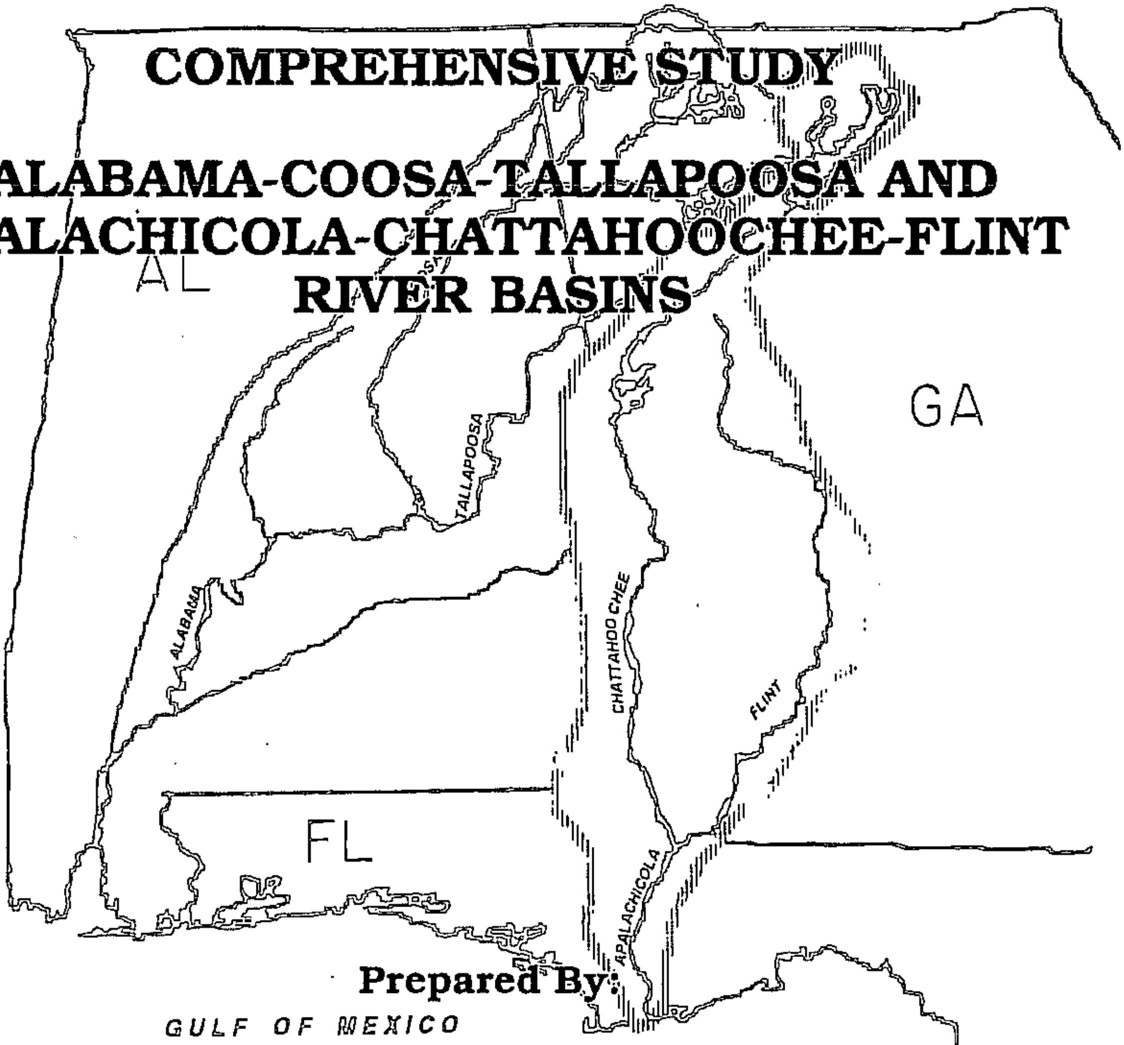
PLAN OF STUDY

COMPREHENSIVE STUDY

ALABAMA-COOSA-TALLAPOOSA AND APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASINS



Prepared By:

THE COMPREHENSIVE STUDY TECHNICAL COORDINATION GROUP

JULY 1991

ENVIRONMENTAL ASSESSMENT

Alabama Power Company Proposal for a Temporary Modified Minimum Flow Agreement in the Alabama River for Drought Water Management Operation in the Alabama-Coosa-Tallapoosa River Basin

Prepared by

U.S. Army Corps of Engineers, Mobile District
Planning and Environmental Division
Environment and Resources Branch
Inland Environment Team

July 2007

levels would occur with Alternatives 5 and 7 corresponding approximately to the increased releases from the lakes that were requested by APC. The figures show that if those release rates were sustained through the drought, water levels would fall approximately 20 feet below winter pool level at Carters Lake and 7 feet below winter pool level at Lake Allatoona. In both lakes, levels would be near or below historic minimum low elevations. Because of the position of these reservoirs in the upper portion of the ACT basin these impacts, over the long term would be greater, and would result in longer time to recover to normal water levels than APC and Corps reservoirs lower in the basin. For example, Lake Allatoona has 7% of the total water storage of all lake projects in the basin, and Carters Lake has 8%. This compares to a single lake owned by APC, Lake Martin which has 32% of the water storage of the ACT basin. Likewise, Carters has a drainage basin of 376 square miles providing runoff to it, Allatoona has a drainage basin of 1,110 square miles, and Lake Martin has 2,984 square miles. Current remaining storage by individual lake is approximately 70-80%, for all lakes. Therefore, the impacts of lake drawdowns are disproportionately larger when considering lakes in the upper drainage basin, especially Lakes Carters and Allatoona which are the uppermost reservoirs in their respective basins.

Flow rates and water depths on the Coosa River would also be impacted by increasing releases from Lakes Allatoona and Carters as described in Alternatives 5-10. Modeling results (Appendix B) show that for the No Action alternative, flows at Rome, Georgia would be 1,561 cfs by 1 August 2007, 1,250 cfs by 1 September 2007, and 1,174 cfs by 1 October 2007. For releases resulting from three hours of hydropower generation per day at Lake Allatoona, flows would be 2,153 cfs on 1 August 2007, 1,455 cfs on 1 September 2007, and 1,625 on 1 October 2007. Releases from Lake Allatoona from three hours of hydropower generation per day would result in the maximum increase in flow at Rome, Georgia of any of the proposed alternatives. Other alternatives involving increased water releases from Lakes Allatoona and/or Carters would result in proportionally less increased flow. Likewise for water elevations at Rome, the results show that for the No Action alternative water depth would be 10.8 feet, 10.5 feet and 10.5 feet on 1 August, 1 September, and 1 October respectively. For increased releases from three hours of hydropower generation per day at Allatoona, depths would be 11.1 feet, 10.7 feet, and 10.8 feet on the same dates respectively. For increased releases of 20% from Lakes Allatoona and Carters water depths would be 11.1 feet, 11.2 feet, and 10.9 feet on the same dates respectively.

Using the HEC-5 model developed during the Comprehensive Water Resources Study, based on the 1939-1993 period the unimpaired (Non parametric IHA Scorecard), 7-day minimum flows at Rome is calculated as 1,408 cfs. Unimpaired flows represent those flows calculated from past data, that would occur without the presence of manmade reservoirs (natural flow). Therefore, the No Action alternative would result in releases below the unimpaired flow, whereas increasing releases to three hours of hydropower generation per day would result in flows exceeding the unimpaired flow by more than 700 cfs.

Water Supply

Because of the hydrological effects described in the above hydrology discussion, water supply to municipal and/or industrial users could be affected depending on location and on the actual drop in water elevation for any of the described alternatives. As shown above, the No Action alternative would have the least impact on water levels on the Alabama River below Montgomery, and therefore would have the least impact on users of water along that reach. For each incremental decrease in flow on the river, water levels would drop and a greater chance that water supplies would be interrupted as drought conditions persist. At the 40% reduction from the minimum flow agreement, water levels at the tailwater of Claiborne Dam would drop approximately 1.5 feet compared to the no action alternative. This compares, as an example, with current conditions at the International Paper Riverdale Paper Mill in Dallas County, Alabama. Tailwater elevation at the R.F. Henry dam was 78.5 feet msl on 12 July 2007. Information supplied by International Paper Company indicated that minimum tailwater elevation to ensure continued water supply was 76.5 feet. Therefore, only at the 40% reduction in flow would that particular industry be threatened with loss of water supply. By contrast tailwater elevations at Claiborne on 12 July 2007 were 6.5 feet msl. For the Alabama River Pulp Company elevations below 5.0 feet would cause the plant to shut down because of lack of water supply according to data supplied by them. The 30% flow reduction would cause a drop of water level by almost 1.0 foot and the 40% flow reduction would cause water levels to drop by more than 1.5 feet, below the company's water intake. At the 10% and 20% flow reductions, projections indicate greater assurance exists that water supplies would be uninterrupted. While modeling results of the alternatives do not allow a quantitative analysis of the effects on water supply intakes downstream of the confluence of the Alabama and Tombigbee River, e.g., City of Mobile and industries such as APC's Barry Steam Plant, some qualitative impact analysis is presented. The water elevations on the Mobile River and lower portion of the Alabama River are more influenced by tidal action than the river flow. Tidal influence extends up the Alabama River approximately 30 miles to near the Dixie Landing area. The more significant concern for water supply intakes in this tidal reach is therefore not elevation, but is salt water intrusion. During the 2000 drought and already during tbe 2007 drought there are concerns about salt water intrusion upstream to some of the key water intakes on the Mobile River. Alternatives that include provisions for reduction of the minimum flow requirements at Montgomery would cause increased saltwater intrusion up the Mobile River; however, the 10% reduction level would be similar to the HEC-5 calculated unimpaired 7-day minimum flow level at Montgomery thus not anticipated to cause significant adverse impacts. Higher percentage reductions in the minimum flows at Montgomery (20%, 30%, or 40%) would have a higher risk for adverse impacts on the Mobile River water supply intakes. Therefore at this time, the recommended plan would be for a 10% reduction followed by frequent stakeholder coordination for these downstream water supply users regarding the status of salinity intrusion in the Mobile River relative to their intake structures.

There are at least three municipal water supply intakes on the APC lakes that could be impacted. The No Action alternative would result in the most rapid lowering of lake levels and would therefore have the greatest chance of interrupting water supplies. The City of Wedowee on Harris Lake has its existing intake at 784 feet msl. The lake level on 12 July 2007 was 786.5 feet and with the No Action alternative would be 782.14 feet by 1 September 2007, and 779 feet in

5. Industrial Demand.

Study Element Objective

Describe and quantify the existing industrial water demand within the ACT and ACF Basins and project industrial water needs through the planning period.

Rationale

Industrial water demand includes not only process water for industrial processes, such as textiles, chemicals, pulp and paper, but also cooling water and steam for fossil fuel and nuclear power plants. These industrial demands are recognized uses of water resources within the basins.

Task Description

46 • Determine existing industrial water demand and locate withdrawals for both groundwater and surface water resources by state, basin, stream segment, and county. (Early)

47 • Determine the foreseeable future water consumption of industries (e.g. by Standard Industrial Classifications) and identify low water demand industries. (Early)

48 • Develop unconstrained industrial water demand requirements, by state, basin, stream segment, county, and metropolitan area, if appropriate, using state projections, industry expectations, OBERS economic growth projections, and other appropriate methods. (Middle)

49 • Recompute industrial water demand requirements considering water conservation practices - including pricing, recirculation, and mandatory controls - and develop conservation scenarios by state, basin, stream segment, county, and metropolitan area. (Middle)

50 • Consider the development of alternative water sources. (Middle)

51 • Determine which industrial sectors could potentially use off-stream storage for industrial water supply. (Middle)

End Results

This study element will result in a document that summarizes the industrial water demand needs and alternatives of the ACT and ACF basins through the year 2050.

80th Congress, 2d Session - - - - - House Document No. 773

ALABAMA-COOSA BRANCH OF THE MOBILE RIVER SYSTEM

(Determination of Salinity Line in Mobile River and its Tributaries)

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, UNITED STATES ARMY, DATED JANUARY 15, 1947, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON A REVIEW OF REPORTS ON ALABAMA-COOSA BRANCH OF THE MOBILE RIVER SYSTEM, WITH A VIEW TO LOCATING AS NEARLY AS CAN BE DETERMINED THE SALINITY LINE IN THE MOBILE RIVER AND ITS TRIBUTARIES, REQUESTED BY A RESOLUTION OF THE COMMITTEE ON RIVERS AND HARBORS, HOUSE OF REPRESENTATIVES, ADOPTED ON OCTOBER 16, 1944

(Pursuant to Public Law 296, 80th Congress)

DECEMBER 29, 1948.—Referred to the Committee on Public Works and ordered to be printed with seven illustrations

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CONTENTS

PLATES

(Plates Nos. 3–5, 9–16, and 18–23 not printed)

LETTER OF TRANSMITTAL

Department of the Army,
Washington, D. C., December 8, 1948.

The Speaker of the House of Representatives.

Dear Mr. Speaker: I am transmitting herewith a report dated January 15, 1947, from the Chief of Engineers, United States Army, together with accompanying papers and illustrations, on a review of reports on Alabama-Coosa Branch of the Mobile River system, with a view to locating as nearly as can be determined the salinity line in the Mobile River and its tributaries. This investigation was requested by a resolution of the Committee on Rivers and Harbors, House of Representatives, adopted on October 16, 1944.

The Bureau of the Budget advises that there is no objection to the submission of the report to Congress.

Sincerely yours,

Kenneth C. Royall,
Secretary of the Army

ALABAMA-COOSA BRANCH OF THE MOBILE RIVER SYSTEM (DETERMINATION OF SALINITY LINE IN MOBILE RIVER AND ITS TRIBUTARIES)

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ENGINEERS,
Washington, January 15, 1947.

The CHAIRMAN, COMMITTEE ON PUBLIC WORKS,
House of Representatives, United States,
Washington, D. C.

MY DEAR MR. CHAIRMAN:

1. The Committee on Rivers and Harbors of the House of Representatives, by resolution adopted October 16, 1944, requested the Board of Engineers for Rivers and Harbors to review the reports on Alabama-Coosa Branch of the Mobile River system, submitted in House Document No. 66, Seventy-fourth Congress, first session, with a view to locating as nearly as can be determined the salinity line in the Mobile River and its tributaries. I enclose the report of the Board in response thereto.

2. The Board recommends that the district engineer's report, with accompanying papers, be printed and made available to the general public.

3. After due consideration of this report, I concur in the views of the Board.

Very truly yours,

R. A. WHEELER,
Lieutenant General, Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

WAR DEPARTMENT,
THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, October 7, 1946.

Subject: Alabama-Coosa Branch of the Mobile River system (determination of salinity line in Mobile River and its tributaries).
To: The Chief of Engineers, United States Army.

1. This report is in response to the following resolution adopted October 16, 1944:

Resolved by the Committee on Rivers and Harbors of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors created under section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the reports on Alabama-Coosa branch of the Mobile River system, submitted in House Document Numbered 66, Seventy-fourth Congress, first session, with a view to locating as nearly as can be determined the salinity line in the Mobile River and its tributaries.

2. The Mobile River, Ala., is formed by the confluence of the Alabama-Coosa and the Tombigbee Rivers, flows southerly 46 miles

and enters Mobile Bay, an estuary of the Gulf of Mexico, at Mobile, Ala. The Alabama-Coosa River is the left-hand branch at the head of Mobile River and is known as the Alabama River below the mouth of Tallapoosa River near Montgomery, Ala., and as Coosa River above that point. Six miles below its source the Mobile River divides, the westerly fork being the continuation of Mobile River while the easterly fork is known as Tensaw River, which enters Mobile Bay several miles east of the mouth of Mobile River. Mobile River ranges from 500 to 1,200 feet in width and from 15 to 45 feet in depth at mean low water. The slope is very flat and banks are generally low. The mean tidal variation at Mobile is 1.25 feet but storm tides rise several feet higher. The principal tributaries of Mobile River are Chickasaw, Three Mile, Briar, and Cedar Creeks.

3. The purpose of the report as stated in the authorizing resolution is to "locate as nearly as can be determined the salinity line in the Mobile River and its tributaries." The district engineer made studies extending from November 1944 to January 1946, during which he tested samples of water collected at 14 ranges, 9 of which were in Mobile River and 1 each in Tensaw, Tombigbee, and Alabama-Coosa Rivers, and Chickasaw and Three Mile Creeks. The river discharge varied from a minimum of about 10,000 second-feet to a maximum of about 120,000 second-feet during the period of tests. A total of 2,320 samples were collected and analyzed to determine the chloride content, turbidity, color, hydrogen-ion, and total hardness.

4. The district engineer finds that the daily tidal variation has very little effect upon the salt concentration in that portion of the Mobile River investigated and that an abnormally high hurricane tide which occurred about April 1, 1945, did not affect the salt intrusion. Salt water reaches range 4, river mile 20.5, only when the flow at the head of the river has decreased to 10,000 second-feet which is about the minimum daily discharge for an average dry period. When the flow approaches or exceeds 15,000 second-feet there is a total displacement of salt water at range 4 and at range 3, mile 13.8, and a sharp decrease in the chloride content at range 2, mile 7.1, and range 1, mile 3.1. When the flow at the head of the river exceeds 50,000 second-feet the chloride content at range 1 decreases to about 12 parts per million which is the normal amount in fresh water streams in that area.

5. The district engineer concludes:

(a) That tidal variation had little if any effect on salt intrusion in the Mobile River under conditions existing during his studies.

(b) The salinity line in the river is not fixed but moves up and down stream with variations in flow, the ingress and egress of the salt water being gradual. Salt water reaches the maximum concentration and extent during the low-water period which usually occurs in the fall of the year.

(c) Salt water intruded up to mile 21 when the flow at the head of the river had decreased to 10,000 second-feet, and it can be expected to progress further upstream under extreme low-flow conditions.

(d) When the flow at the head of the river exceeds 50,000 second-feet the river water can be considered to be fresh throughout the entire length of Mobile River.

(e) Under conditions existing during the testing period salt-water intrusions into Mobile River can be expected between June 1 and January 15, but from January 15 to June 1 flood stages usually prevail and the water throughout the entire river can be considered to be fresh.

The district engineer recommends that his report and accompanying papers be printed and made available to local interests. The division engineer concurs.

VIEWS AND RECOMMENDATIONS OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

6. The Board concurs in the conclusions and recommendation of the reporting officers. It is apparent that salt-water intrusion into Mobile River begins when the flow at the head of the river falls to about 50,000 second-feet, progresses gradually upstream as the discharge decreases and reaches the vicinity of river mile 21 when the flow falls to about 10,000 second-feet. Under extreme low-water conditions when the flow is less than 10,000 second-feet the upstream limit of salt-water intrusion would probably be above river mile 21. The graphs on plate 15 and 16 accompanying the district engineer's report indicate that, with the exception of a value of about 22 parts per million at range 10 in the latter part of November 1944, the chloride content did not exceed 17 parts per million at ranges 5, 6, 7, 8, 9, and 10 during the test period. It therefore appears that the main Mobile River and tributaries above mile 26.2 (range 5) were practically free from salt-water intrusion during the test period. The graph on plate 9 for the Chickasaw Creek range located 3.7 miles above the mouth of the creek indicates that there was pronounced intrusion into the lower reaches of the creek and the concentration in the creek was practically the same as in the main river at the mouth of the creek (range 1) between August 20 and December 20, 1945. The graph on plate 9 for the Three Mile Creek range located 1 mile above the mouth of the creek indicates pronounced intrusion of salt water into that creek during approximately the same period of the year. The Board concludes that the location of the salinity line in Mobile River, Ala., varies within the limits defined above as the flow in the river changes and cannot be definitely fixed. The Board recommends that the district engineer's report, with accompanying papers, be printed and made available to the general public.

For the Board:

R. C. CRAWFORD,
Brigadier General, Senior Member.

REVIEW REPORT ON ALABAMA-COOSA BRANCH OF THE MOBILE RIVER SYSTEM FOR DETERMINATION OF SALINITY LINE IN MOBILE RIVER AND ITS TRIBUTARIES

SYLLABUS

The district engineer conducted field investigations and laboratory analyses during the period November 1944 through January 1946 to determine as accurately as possible the upper limits of salt-water intrusion in the Mobile River and its tributaries. The ultimate purpose of the study was to furnish data on water supply for the development of water side industrial sites in the Mobile Harbor area. In addition to the salinity study, laboratory tests were made to determine the turbidity, color, hardness, and pH (hydrogen-ion) of the water at various points along the river.

The results of all laboratory tests are presented in tabular form in the report. From a study of these results, the following general conclusions were derived:

(*a*) Under conditions encountered in this study, tidal variation has little, if any, effect on salt intrusion in the Mobile River.

(*b*) The farthest point upstream reached by salt-water intrusion during the study was slightly above mile 21 on Mobile River and this lasted for only a short time. It can be expected that this upstream limit would be exceeded during extreme low-water conditions in the Mobile River.

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(c) The chloride concentration is dependent on the river discharge and displacement of salt in the upper reaches in the river is noticeable when the discharge exceeds 10,000 cubic feet per second at the head of the Mobile River. When the discharge exceeds 50,000 cubic feet per second water can be considered fresh from the head to the mouth of the river.

Since this report presents technical and factual data, the district engineer recommends that the report and accompanying papers be printed and made available to local interests.

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE,
Mobile, Ala., May 1, 1946.

Subject: Review of reports on Alabama-Coosa Branch of the Mobile River system for determination of salinity line in Mobile River.
To: Division Engineer, South Atlantic Division, Atlanta, Ga.

AUTHORITY

1. This report is submitted in compliance with the following resolution, adopted October 16, 1944:

Resolved by the Committee on Rivers and Harbors of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors created under section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the reports on the Alabama-Coosa branch of the Mobile River system, submitted in House Document Numbered 66, Seventy-fourth Congress, first session, with a view to locating as nearly as can be determined the salinity line in the Mobile River and its tributaries.

The duty of preparing the report was assigned to the district engineer by the division engineer in first endorsement dated October 20, 1944, on letter from the Office, Chief of Engineers, dated October 18, 1944, subject, Mobile River Salinity Study.

NATURE OF REPORTS UNDER REVIEW

2. House Document No. 66, Seventy-fourth Congress, first session, contains reports on the Alabama-Coosa branch of the Mobile River system made under the provisions of House Document No. 308, Sixty-ninth Congress, first session, which was enacted into law, with modifications, in section 1 of the River and Harbor Act of January 21, 1927. These reports considered the comprehensive development of the Alabama and Coosa Rivers for navigation, flood control, and hydroelectric power. No specific improvements or recommendations were included for the Mobile River, which is the subject of the present report. The district engineer concluded that further improvement of the river system should not be undertaken at that time and recommended that the project for the Coosa River be abandoned due to the lack of navigation. The division engineer concurred in the recommendations of the district engineer; the Board of Engineers for Rivers and Harbors and the Chief of Engineers did likewise, except for abandonment of the then-existing Coosa River improvement.

SCOPE OF REPORT

3. This report was authorized at the request of local interests in Mobile, Ala., to determine, if practicable, the upper limits of salt-water intrusion in the Mobile River and its tributaries. Its ultimate purpose is to furnish data on water supply for the development of

waterside industrial sites in the Mobile Harbor area; it therefore indirectly affects future navigation on the Mobile River. Since it is a limited technical and factual report, the usual considerations of navigation, flood control, water power, economics, and commerce are omitted.

4. The studies made by the district engineer, involving field investigations and laboratory analyses, covered a period from November 1944 through January 1946. In addition to the salinity study, laboratory tests were made to determine the turbidity, color, hardness, and pH of the water at various points along the river. The report describes the extent of the survey, the equipment used, the methods followed, and the results obtained.

DESCRIPTION

5. *Mobile River.*—The Mobile River is formed by the confluence of the Tombigbee and Alabama Rivers and flows south 46 miles, emptying into Mobile Bay, an estuary of the Gulf of Mexico, at Mobile, Ala. Six miles below its source, the river forks; the west fork is a continuation of the Mobile River and the east fork forms the Tensaw River, which flows into Mobile Bay several miles east of the mouth of the Mobile River. The Tensaw River parallels the Mobile River for its entire length, the two rivers being 1½ to 6 miles apart, separated by heavily wooded swampland. The Mobile River flows close to the west rim of the basin and occasionally cuts into the side of the escarpment to form high bluffs. In general, the banks are low, ranging from 3 to 8 feet high. The river varies from 500 to 1,200 feet wide and is 15 to 45 feet deep at mean low water. The slope is very flat at low river stages and during those periods the average tidal variation at Mount Vernon landing, mile 41, is only about 0.4 foot less than that at Mobile. From the Louisville & Nashville Railroad bridge (mile 13.7) to the mouth of Chickasaw Creek, the river flows through a swamp area covered with marsh grass. The banks in this reach are very low, averaging from 1 to 2 feet high. The width varies from 500 to 800 feet, and the depth from 14 to 30 feet. The principal tributaries of the Mobile River are Chickasaw, Three Mile, Briar, and Cedar Creeks.

6. *Chickasaw Creek.*—Chickasaw Creek rises in Mobile County about 22 miles north and 5 miles west of Mobile. It flows southeasterly and joins the Mobile River about 1 mile above Mobile.

7. From its headwaters to a point about 9 miles above the mouth, the creek varies from 10 to 75 feet wide, and the banks from 5 to 10 feet high. Although the slope was not determined by levels, topographic maps of this area indicate that the slope averages about 5 feet per mile.

8. From that point Chickasaw Creek gradually widens to about 500 feet near the mouth. In this reach it flows through swamplands, the slope being very flat. The depth ranges from 5 to 40 feet.

9. *Three Mile Creek.*—Three Mile Creek rises in Mobile County approximately 6 miles west of Mobile and drains an area of about 22 square miles. It flows easterly 13 or 14 miles to join the Mobile River about 4 miles above its mouth. For about 11 miles from the headwaters the creek is narrow and shallow, ranging from 10 to 30 feet wide and from 8 feet to less than 1 foot deep. From a point 2½ miles above the mouth the creek flows through swampland and is

mostly in backwater from the Mobile River. The banks are low, and the prolific growth of water grass necessitates annual clearing of the channel upstream as far as mile 2.5 to keep it open for river traffic.

10. Although its slope has not been established exactly, it is evident that the slope from the headwater to mile 5 is fairly steep, possibly as much as 10 feet to the mile in some reaches. From mile 3 to the mouth the slope is comparatively flat. Several sanitary sewers from Mobile empty into the creek near Davis Avenue; below that point the creek is highly polluted.

11. *Mobile.*—According to the 1940 census, the population of Mobile is 78,720. However, due to the influx of workers and others during the war, the present population is much greater. Mobile is a port of entry and a shipping outlet for an area extending to the Great Lakes and into the Midwest. Its industries include an aluminum-ore processing plant, two large ship-building yards, two large paper mills, and numerous smaller industrial plants. Commerce of the harbor consists principally of petroleum and its products, wood, paper, iron and steel products, coal, and miscellaneous freight. The normal average annual tonnage based on the 10-year period from 1935 to 1944 is 4,295,653 tons.

DESCRIPTION OF METHODS, EQUIPMENT, AND PROCEDURES

12. *General.*—The intrusion of salt water in the Mobile River was studied from November 1944 to January 1946. Water samples were taken about every 2 weeks. In order to ascertain the movement of salt water, 14 ranges were established, 9 on the Mobile River, 1 near the source of the Tensaw River, 1 near the mouth of the Tombigbee River, 1 near the mouth of the Alabama River, 1 on Three Mile Creek and 1 on Chickasaw Creek. The locations of the ranges are shown on the general map, plate 1, and also on the profile of the Mobile River, plate 2. The ranges are described below:

Range 1: Mobile River, 100 feet upstream from the mouth of Chickasaw Creek, and about 2,000 feet above Bay Bridge, 3.1 miles upstream from the foot of Government Street, Mobile. Width of range, about 1,500 feet; depth approximately 18 feet at middle of channel.

Range 2: Mobile River, at the south end and west side of Twelve Mile Island in Mobile River, mile 7.1 above Government Street, Mobile. Width about 650 feet; depth about 30 feet at middle of channel.

Range 3: Mobile River, at mile 13.8, about 1,000 feet above the Louisville and Nashville Railroad bridge. Width about 800 feet; depth at middle of channel about 20 feet.

Range 3–A: Mobile River, at mile 15.4. Width about 800 feet; depth about 14 feet.

Range 3–B: Mobile River, at mile 17.1, 200 feet above Bayou Canot. Width about 1,000 feet; depth about 20 feet.

Range 4: Mobile River, at mile 20.5, about 100 feet above mouth of Little Lizard Creek, 3,000 feet below high-voltage transmission power line of Alabama Power Co. Width about 700 feet; depth about 35 feet.

Range 5: Mobile River, at mile 26.2, at Twenty-Seven Mile Bluff, about 1 mile below Whitehorse Bend. Width about 500 feet; approximate depth 35 to 40 feet.

Range 6: Mobile River, at mile 34.7, about one-half mile below Chestang Bluff. Width about 500 feet; depth about 40 feet.

Range 7: Tensaw River, about 1 mile downstream from the head of Tensaw River. Width about 700 feet; depth about 25 feet.

Range 8: Mobile River, at mile 40, about 1 mile downstream from Mount Vernon landing. Width about 900 feet; approximate depth 35 feet.

Range 9: Tombigbee River, at about mile 2.0 above mouth of Tombigbee River and about 2.5 miles downstream from Blue Ford landing. Width about 750 feet; depth about 30 feet.

Range 10: Alabama River, about 2.7 miles above mouth of Alabama River. Width about 600 feet; depth about 25 feet.

Chickasaw Creek: About 3.7 miles above mouth of Chickasaw Creek, on United States Highway No. 43 bridge 1 mile north of Chickasaw.

Three Mile Creek: About 1.0 mile above mouth of Three Mile Creek on downstream side of United States Highway No. 43 and 31 concrete bridge over Three Mile Creek.

13. *Field equipment.*—Observations were made from a boat of the type shown on plate 5. The boat is about 34 feet long with a 9-foot beam, and is powered by a 95-horsepower gasoline motor; its maximum speed is 8 miles per hour.

14. A standard type A stream-gaging derrick was so mounted on the boat that it could be assembled or dismantled in a few minutes. When dismantled, the derrick required little storage space and did not interfere with the operation of the boat for its other uses.

15. A type D reel with 75 feet of 0.10-inch wire cable with an insulated wire in the center was used with the derrick. A harness snap hook attached to the free end of the cable provided quick coupling of the sampler to the cable. The reel was equipped with a depth indicator and was manually operated. Two terminals were provided on the reel for electric connection to a battery. The wire cable was grounded to one of these terminals, and the insulated copper wire connected to the other. A photograph of the derrick mounted on the boat is shown on plate 4.[1]

16. *Sampling device.*—An electromagnetic point sampler, designed and constructed by the mobile engineer district for this particular study, was used. A photograph of the sampler is shown on plate 3[1] and a detailed sketch is given on plate 6. The U-shaped frame and weight for carrying the magnetic trap is shown on plate 4.[1]

17. The magnetic trap consists of a quart glass jar in which the sample is retained, and a three-fourths-inch brass tube 8 inches long which contains the valve mechanism. Water is admitted to the jar container through ports on opposite sides of the tube, 1 inch from the bottom. The valve mechanism consists essentially of three parts—the valve seat, an eleven-sixteenths-inch steel ball, and the electromagnet.

18. The valve seat consists of a three-fourths-inch brass collar three-fourths inch long and one-half inch inside diameter. The inside diameter is beveled to form a seat for the steel ball. The seat is held

[1] Not printed.

in place inside the tube (flush with the bottom edge of the portholes in the tube) by a set screw. This allows control of the distance between the valve seat and the electromagnet.

19. The steel ball moves freely up or down inside the tube. The valve is closed when the ball rests on the valve seat. The magnet lifts the steel ball from the valve seat when an electrical current is passed through the coil, and water then passes through the ports into the jar container.

20. The electromagnet consists of two layers of tightly wound No. 22 magnet wire over a one-half-inch iron core 5 inches long. Its position inside the tube is stationary after being adjusted so that the ball will be lifted three-sixteenths inch when the valve is open. One lead from the coil is grounded to the brass tube, and the other connected to the terminal projecting from the top of the tube. The magnetic coil assembly is made watertight and held in a fixed position with an insulating sealing compound.

21. To operate the sampler, the magnetic trap is placed in the weighted carrier attached to the cable on the reel. The electrical connections are made between the sampler and cable, and the trap lowered to the desired depth. The circuit is closed by means of a snap switch on the reel. The electromagnet attracts the ball to the coil, which opens the ports, allowing water to enter the jar container. Air escapes from the jar through a one-fourth-inch brass tube 5 inches long with flap valve. Air pressure inside the jar forces the flap valve open when the sampler is opened. The exhaust tube is supported by a copper band soldered to the brass tube containing the magnetic valve mechanism.

22. *Laboratory operations.*—The following tests were included in the analyses of the samples: Chloride, turbidity, color of water, hydrogen-ion (pH), and total hardness.

23. All samples collected from the ranges were tested individually to determine the turbidity and chloride content. Color, pH, and total hardness were determined from composite or representative samples collected from each range.

24. *Determination of chloride.*—Chloride is determined by precipitation of the chlorides as silver chloride in the presence of potassium chromate indicator. The end point of the titration is shown by a reddish color produced by a slight excess of silver nitrate ($AgNO_3$) solution reacting with the potassium chromate (K_2CrO_4) indicator. Silver nitrate solutions used were standardized by titration against normal sodium chloride solutions.

25. *Turbidity.*—Suspended matter as reported in water analyses is the weight in parts per million of the suspended or insoluble material carried by the water. The turbidity of water is a measure of the obstruction to passage of light by suspended material. The turbidity of water was established for this study by use of the Jackson turbidimeter. This instrument gives a direct reading of turbidity and covers a range from 25 to 5,000 parts per million.

26. *Color.*—Color is due to organic matter dissolved in the water, and in surface water is caused almost entirely by organic matter from leaves, roots, and other substances in the ground. An instrument similar to the Taylor water analyzer was used in determining the color of water for this study; this gives a direct reading for the color of

water. The color slide contained color standards for water ranging from 0 to 70 parts per million.

27. *Hydrogen-ion concentration (pH)*.—The hydrogen-ion concentration is commonly reported as pH. Technically pH is the logarithm of the reciprocal of the hydrogen-ion concentration in gram-atoms per liter, but simply it is merely a number denoting the degree of acidity or alkalinity. A pH value of 7.0 means that the water is neither acid nor alkaline. Values higher than 7.0 denote increasing alkalinities; values lower than 7.0 denote increasing acidity. The colorimetric method of determining pH was adopted in preference to the electrimetric method because the water tested usually fell within the range of one color disk (6.0 to 7.6); also this method is convenient and its accuracy was considered adequate for this study. The apparatus used consisted of a Hellige pocket comparator, a color disk reading in steps of 0.2 pH from 6.0 to 7.6 pH, and a Brom thymol blue indicator specified by the manufacturer.

28. *Hardness*.—Hardness of water is that property which causes it to require excess soap to produce a lather or causes incrustation on pipes or other vessels in which it is heated. Hardness is caused almost entirely by calcium and magnesium and is commonly reported as calcium carbonate ($CaCO_3$) equivalent to calcium and magnesium. The soap method used to determine total hardness is a fast, approximate method. While its limitations are fully realized, this method was considered accurate enough within the limits of this study.

29. *Results of laboratory analyses*.—Chloride tests were made on 2,320 samples during the study. In general, nine water samples were obtained at each main river range; i. e., surface, middle, and bottom at three sections across the river. Turbidity was determined for the same number of samples. Composite samples (surface, middle, and bottom for channel section) were used in the determination of color, hardness, and pH. The results of all analyses for each range are given in tables 1 to 14.

30. Studies were made to show the salt intrusion in the Mobile River under extreme low- and high-water conditions and also the duration of the salt intrusion at the various main-river ranges. Plate 7 shows the isochlor pattern in the Mobile River under maximum and minimum flow conditions during the period November 1944 through January 1946.

31. Plate 8 shows the duration and amount of chloride recorded at the bottom of the river for the five lowermost ranges.

32. Plates 9 to 16 [1] show the amount of chloride recorded at each range. These charts indicate the variance of chloride from the bottom to the surface.

[1] Not printed.

TABLE 1.—*Results of laboratory tests—Range 1, Mobile River 3.1 miles above Government St.*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples									
						Turbidity			Composite samples			Chloride in parts per million			
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
			----	0	----	----	----	----				----	4,450	----
Nov. 9, 1944	3:25 p. m.	66	----	10	----	----	----	----	----	----	----	----	5,000	----
			----	19	----	----	----	----				----	12,000	----
			0	----	0	30	----	32				586	----	532
Nov. 29, 1944	10:15 a. m.	54	9	----	9	35	----	43	30	7.4	108	638	----	709
			16	----	16	41	----	47				2,127	----	2,837
			0	----	0	----	----	----				1,400	----	1,850
Dec. 9, 1944	9:55 a. m.	----	10	----	10	----	----	----	----	7.3	202	1,700	----	2,150
			18	----	10	----	----	----				12,400	----	11,500
			0	0	0	47	57	57				307	150	131
Jan. 4, 1945	11:30 a. m.	----	13	10	14	57	63	63	25	7.6	152	415	381	470
			25	31	26	47	123	119				10,200	10,635	9,900
			0	0	0	87	91	110				18	18	19
Jan. 18, 1945	10:30 a. m.	----	8	0	0	87	100	120	120	7.4	54	18	18	19
			14	17	18	88	108	120				18	18	20
			0	0	0	85	80	75				400	400	390
Jan. 31, 1945	11:35 a. m.	----	7	8	8	79	83	74	100	7.4	54	450	460	400
			12	15	15	91	102	85				450	070	010
			0	0	0	110	105	120				18	10	18
Feb. 14, 1945	10:05 a. m.	51	7	0	0	123	140	150	150	7.3	46	19	19	19
			13	10	10	122	145	157				10	20	19
			0	0	0	80	75	88				13	12	12
Mar. 7, 1945	9:15 a. m.	63	8	9	8	84	80	90	135	7.4	42	12	13	13
			14	17	15	83	81	95				13	13	12
			0	0	0	64	68	57				12	12	11
Mar. 21, 1945	9:15 a. m.	----	7	9	8	62	54	65	90	7.4	40	12	11	11
			15	17	15	62	54	63				11	11	13
			0	0	0	61	62	72				12	11	10
Apr. 3, 1945	9:40 a. m.	----	9	11	9	68	65	78	120	7.5	40	11	12	10
			16	20	16	70	70	76				11	11	11
			0	0	0	77	80	85				8	8	8
Apr. 11, 1945	9:50 a. m.	60	8	10	9	82	85	90	100	7.3	46	8	8	8
			15	18	16	85	89	93				8	8	8
			0	0	0	52	52	57				12	13	12
Apr. 25, 1945	9:14 a. m.	72	8	10	10	82	85	90	100	7.0	52	11	13	12
			14	18	18	85	80	93				11	13	13
			0	0	0	65	70	73				7	9	8
May 9, 1945	4:50 p. m.	----	8	10	9	73	77	80	120	7.0	40	8	9	9
			15	18	17	75	80	81				8	10	8

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May 23, 1945	4:10 p. m.		0	0	0	78	77	79	90	6.8	40	10	10	11
			4	0	0	84	92	90				11	11	11
			7	17	16	93	93	109				10	11	11
June 6, 1945	4:50 p. m.		0	0	0	32	30	30	20	7.5	186	248	230	230
			9	9	9	32	32	35				248	372	301
			15	17	16	41	25	34				2,423	8,510	7,328
June 20, 1945	4:30 p. m.	95	0	0	0	24	24	23	50	7.3	154	58	27	39
			8	9	9	24	24—	24				108	100	301
			14	16	16	25	25	25				259	851	688
July 3, 1945	4:05 p. m.	88	0	0	0	30	28	29	50	7.5	192	67	32	35
			8	9	9	32	34	34				151	260	300
			14	17	17	24—	24—	24—				8,806	9,002	10,874
July 25, 1945	4:35 p. m.	85	0	0	0	32	32	33	30	7.5	198	1,861	1,709	1,737
			8	11	9	26	45	56				2,376	2,462	2,057
			15	20	17	28	25	26				4,468	7,021	7,121
Aug. 8, 1945	4:20 p. m.	87	0	0	0	26	28	28	10	7.5	182	319	101	184
			8	10	9	28	38	30				307	723	539
			15	18	17	25—	25—	25—				9,383	9,113	7,588
Aug. 22, 1945	4:30 p. m.		0	0	0	(1)	(1)	(1)	15	7.5	256	1,915	1,773	1,808
			7	10	9	(1)	(1)	(1)				3,068	3,600	3,127
			12	18	16	(1)	(1)	(1)				4,190	9,912	10,150
Sept. 5, 1945	4:30 p. m.	87	0	0	0	(1)	(1)	(1)	20	7.6	272	3,127	3,363	3,304
			8	10	9	(1)	(1)	(1)				3,540	5,770	4,960
			14	18	16	(1)	(1)	(1)				12,670	11,695	10,720
Sept. 19, 1945	4:20 p. m.	84	0	0	0	(1)	(1)	(1)	10	7.5	220	2,655	2,714	2,655
			6	10	9	(1)	(1)	(1)				2,837	3,015	2,925
			11	18	16	(1)	(1)	(1)				5,230	9,131	8,776
Oct. 10, 1945	3:50 p. m.	77	0	0	0	(1)	(1)	(1)	15	7.5	268	2,303	2,445	2,550
			8	9	7	(1)	(1)	(1)				2,655	3,535	2,675
			14	16	13	(1)	(1)	(1)				11,347	12,400	11,610
Oct. 24, 1945	4:25 p. m.	71	0	0	0	(1)	(1)	(1)	10	7.5	224	2,766	2,943	2,908
			9	9	9	(1)	(1)	(1)				4,071	4,130	4,366
			14	16	17	(1)	(1)	(1)				5,900	7,375	9,204
Nov. 7, 1945	4:10 p. m.	69	0	0	0	(1)	(1)	(1)	15	7.6	252	2,660	2,482	2,482
			6	9	9	(1)	(1)	(1)				2,590	3,593	4,130
			10	16	10	(1)	(1)	(1)				5,000	10,656	9,676
Nov. 21, 1945	3:10 p. m.		0	0	0	(1)	(1)	(1)	10	7.5	200	3,475	3,332	3,689
			8	10	9	(1)	(1)	(1)				3,953	4,012	3,776
			15	18	17	(1)	(1)	(1)				8,142	9,490	9,499
Dec. 5, 1945	3:50 p. m.		0	0	0	31	27	20	20	7.5	220	1,276	1,009	1,025
			7	8	8	35	37	31				1,410	1,380	1,534
			12	14	15	60	50	53				10,561	15,930	13,098
Dec. 19, 1945	3:35 p. m.		0	0	0	45	54	53	70	7.1	44	42	34	28
			7	8	8	53	52	73				42	34	28
			12	15	14	65	63	75				51	34	28
Jan. 9, 1946	2:10 p. m.		0	0	0	117	120	136	135	6.8	34	11	11	11
			8	9	8	130	133	150				11	11	11
			14	17	14	170	170	154				11	11	11

[1] Less than 25.

TABLE 2.—*Results of laboratory tests—Range 2, Mobile River 7.1 miles above Government St.*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples								
						Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
Nov. 9, 1944	2:55 p. m.	----	----	0	----	----	----	----	----	----	----	----	2,600	----
			----	15	----	----	----	----				----	4,450	----
			----	29	----	----	----	----				----	12,600	----
Nov. 29, 1944	9:30 a. m.	----	0	----	0	43	----	32	35	6.7	154	108	----	142
			13	----	16	45	----	40				160	----	177
			24	----	31	42	----	47				528	----	586
Dec. 6, 1944	8:35 a. m.	----	0	----	0	----	----	----	----	7.2	194	950	----	950
			10	----	10	----	----	----				5,300	----	3,700
			18	----	10	----	----	----				12,500	----	12,300
Jan. 4, 1945	11 a. m.	----	0	0	0	103	80	75	55	7.4	56	25	23	21
			10	16	10	120	100	110				21	23	21
			19	31	18	130	150	111				21	23	21
Jan. 18, 1945	10 a. m.	----	0	0	0	80	82	75	120	7.7	60	17	17	18
			11	15	9	92	93	100				15	15	17
			20	28	16	92	93	95				16	16	17
Jan. 31, 1945	11 a. m.	----	0	0	0	89	109	85	120	7.8	66	23	20	19
			12	14	11	96	110	106				22	19	18
			21	26	21	98	123	126				24	20	19
Feb. 14, 1945	9:30 a. m.	51	0	0	0	105	110	100	135	7.3	46	23	19	18
			11	15	9	102	111	125				23	19	18
			20	28	17	110	120	123				23	16	19
Mar. 7, 1945	8:35 a. m.	63	0	0	0	67	97	69	130	7.6	46	13	11	11
			10	15	7	69	70	68				13	10	11
			19	29	12	67	70	69				13	12	10
Mar. 21, 1945	8:45 a. m.	66	0	0	0	50	52	58	90	7.3	46	10	11	11
			10	14	11	49	57	60				11	11	9
			19	27	20	53	56	64				11	11	10
Apr. 3, 1945	10:25 a. m.	----	0	0	0	61	61	60	120	7.7	44	11	10	10
			7	16	7	58	67	70				11	10	10
			13	31	13	64	74	71				10	10	11
Apr. 11, 1945	9:15 a. m.	66	0	0	0	77	80	85	100	7.3	44	9	8	8
			11	15	10	82	85	90				10	8	8
			20	20	19	85	89	93				8	8	8
Apr. 25, 1945	8:45 a. m.	72	0	0	0	54	59	67	90	7.3	48	10	10	11
			10	15	11	56	70	60				10	10	10
			18	29	20	85	60	73				11	12	11
May 9, 1945	4:15 p. m.	----	0	0	0	67	73	72	120	7.0	38	8	8	7
			8	16	0	73	77	74				7	8	8
			15	30	17	77	82	75				8	8	7

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May 23, 1945	3:40 p. m.	70	0 4 7	0 15 29	0 8 15	85 85 93	80 94 100	80 85 98	90	7.1	38	8 8 8	9 8 8	8 8 8
June 6, 1945	4:15 p. m.	82	0 0 16	0 14 27	0 12 23	31 37 48	20 32 24	29 33 24	20	7.2	176	124 121 1, 454	142 2, 014 8, 014	177 230 8, 097
June 20, 1945	4 p. m.	86	0 8 14	0 14 27	0 12 22	25 28 28	24 24 44	27 26 27	60	7.3	178	53 82 105	35 62 374	67 73 130
July 3, 1945	3:35 p. m.	83	0 6 11	0 13 24	0 8 14	27 28 29	25 27 24—	27 27 28	50	7.5	170	20 50 105	20 268 8, 628	21 27 5, 354
July 25, 1945	4:15 p. m.	85	0 10 19	0 15 29	0 11 20	38 47 68	40 41 41	39 54 50	60	7.5	186	345 503 1, 170	370 553 922	362 532 1, 223
Aug. 8, 1945	3:50 p. m.	87	0 10 19	0 15 29	0 13 24	27 60 130	28 26 28	27 38 24	10	7.5	172	41 110 2, 588	43 454 3, 404	37 234 3, 510
Aug. 22, 1945	3:55 p. m.		0 10 18	0 15 28	0 14 26	(1) (1) (1)	(1) (1) (1)	(1) (1) (1)	15	7.5	204	1, 596 3, 120 8, 014	1, 773 5, 957 9, 322	1. 842 4, 484 8, 014
Sept. 5, 1945	3:55 p. m.		0 6 10	0 15 29	0 11 21	(1) (1) (1)	(1) (1) (1)	(1) (1) (1)	10	7.6	264	1, 598 1, 770 9, 204	1, 418 10, 384 12, 036	1, 488 9, 260 10, 738
Sept. 19, 1945	3:45 p. m.		0 9 16	0 15 29	0 15 29	(1) (1) (1)	(1) (1) (1)	(1) (1) (1)	10	7.5	212	1, 667 1, 770 4, 425	1, 702 3, 127 8, 142	1, 631 3, 009 9, 070
Oct. 10, 1945	3:15 p. m.		0 8 15	0 0 17	0 10 18	(1) (1) (1)	(1) (1) (1)	(1) (1) (1)	15	7.5	100	887 1, 132 10, 429	818 7, 132 9, 160	854 1, 025 10, 950
Oct. 24, 1945	4:25 p. m.		0 8 14	0 9 16	0 9 17	(1) (1) (1)	(1) (1) (1)	(1) (1) (1)	10	7.6	212	1, 773 1, 879 2, 596	1, 702 3, 227 6, 844	1, 773 2, 766 9, 704
Nov. 7, 1945	3:35 p. m.	68	0 9 15	0 14 27	0 9 17	(1) (1) (1)	(1) (1) (1)	(1) (1) (1)	15	7.5	200	1, 259 1, 383 6, 136	1, 152 2, 624 9, 440	1, 162 1. 489 6, 785
Nov. 21, 1945	2:40 p. m.		9 9 17	0 15 29	0 10 18	(1) (1) (1)	(1) (1) (1)	(1) (1) (1)	10	7.5	212	1, 773 2, 005 6, 136	1, 681 2, 773 9, 617	1, 649 1, 888 5, 192
Dec. 5, 1945	3:20 p. m.	52	0 9 17	0 14 26	0 10 18	31 35 35	33 38 35	34 37 35	20	7.5	220	278 372 922	259 425 11, 850	277 355 1, 276
Dec. 19, 1945	3:05 p. m.	48	0 11 20	0 14 27	0 11 20	61 60 57	58 60 140	57 70 85	70	7.0	46	27 32 32	25 25 26	25 25 23
Jan. 9, 1946	1:40 p. m.	55	0 9 10	0 15 29	0 10 18	117 125 129	115 138 143	129 132 144	135	6.8	34	11 10 11	10 11 10	12 11 12

[1] Less than 25.

D-00011212.0016

TABLE 3.—*Results of laboratory tests—Range 3, Mobile River 13.8 miles above Government St.*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples								
						Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
			---	0	---	---	---	---				---	330	---
Nov. 9, 1944	1:05 p. m.	65	---	9	---	---	---	---	---	---	---	---	300	---
			---	17	---	---	---	---				---	10,100	---
			0	---	0	35	---	46				21	---	21
Nov. 29, 1944	9 a. m.	65	8	---	9	49	---	64	45	7.6	44	23	---	21
			14	---	17	53	---	67				21	---	21
			0	---	0	---	---	---				50	---	40
Dec. 9, 1944	8:35 a. m.	---	10	---	10	---	---	---	---	7.2	46	215	---	555
			18	---	19	---	---	---				11,300	---	11,200
			0	0	0	108	140	110				16	16	16
Jan. 4, 1945	9:10 a. m.	---	9	9	9	110	150	130	70	7.4	64	19	19	16
			17	17	17	110	148	135				16	16	16
			0	0	0	80	100	91				15	14	13
Jan. 18, 1945	8:33 a. m.	---	12	10	8	80	102	93	120	7.4	50	15	12	14
			22	18	14	92	99	96				15	15	14
			0	0	0	95	114	99				15	15	14
Jan. 31, 1945	10 a. m.	---	8	8	8	96	112	99	120	7.2	48	14	14	15
			15	14	15	98	120	102				15	14	15
			0	0	0	112	120	110				14	14	17
Feb. 14, 1945	8:35 a. m.	51	8	9	8	113	120	120	135	7.3	46	14	15	16
			14	17	14	110	135	120				17	14	15
			0	0	0	64	67	65				9	9	8
Mar. 7, 1945	7:50 a. m.	---	9	9	9	64	66	66	130	7.0	40	8	8	8
			16	17	17	67	70	68				8	9	9
			0	0	0	55	54	53				8	8	8
Mar. 21, 1945	7:55 a. m.	66	8	9	9	52	60	59	90	7.3	42	7	8	8
			15	17	17	54	57	55				8	8	8
			0	0	0	73	70	74				8	8	8
Apr. 3, 1945	11:35 a. m.	66	7	10	5	76	77	75	120	7.5	44	8	8	8
			13	18	8	86	80	76				8	8	8
			0	0	0	77	82	82				7	7	7
Apr. 11, 1945	8:30 a. m.	---	7	9	11	89	89	87	100	7.3	44	7	7	7
			13	16	20	90	91	85				7	7	7
			0	0	0	49	70	57				10	10	9
Apr. 25, 1945	7:45 a. m.	72	8	10	10	51	80	64	80	7.0	52	9	8	8
			15	19	18	55	88	67				10	8	7
			0	0	0	74	79	75				7	7	7
May 9, 1945	3:20 p. m.	---	8	11	10	70	77	74	120	7.0	40	7	7	7
			14	20	18	79	79	75				7	7	7

May 23, 1945	2:50 p. m.	70	0	0	0	90	93	90	90	7.0	38	8	8	8
			8	10	8	91	97	95				8	8	8
			15	10	16	97	100	95				8	8	8
June 6, 1945	3:23 p. m.	85	0	0	0	29	20	20	75	7.3	40	10	10	10
			7	9	8	32	32	32				10	11	10
			13	16	15	32	34	33				10	11	11
June 20, 1945	3 p. m.	85	0	0	0	27	30	24	80	7.3	42	11	11	11
			8	0	8	30	31	27				12	11	11
			14	16	15	33	32	20				11	11	11
July 3, 1945	2:45 p. m.	88	0	0	0	(1)	(1)	(1)	65	7.3	46	10	10	10
			7	9	8	(1)	(1)	(1)				10	11	10
			12	16	14	(1)	(1)	(1)				10	11	11
July 25, 1945	3:07 p. m.	85	0	0	0	34	36	35	100	7.4	44	13	13	13
			8	9	8	34	37	34				13	14	13
			14	17	15	36	37	35				13	15	13
Aug. 8, 1945	2:55 p. m.	87	0	0	0	28	30	34	50	7.5	42	10	10	11
			8	10	9	27	27	28				10	11	10
			16	19	17	27	27	28				11	11	10
Aug. 22, 1945	3 p. m.		0	0	0	(1)	(1)	(1)	20	7.4	144	177	742	320
			8	9	9	(1)	(1)	(1)				302	1,081	478
			14	17	16	(1)	(1)	(1)				4,803	6,205	5,400
Sept. 5, 1945	3 p. m.	87	0	0	0	(1)	(1)	(1)	20	7.6	120	103	212	220
			8	9	9	(1)	(1)	(1)				692	852	1,312
			15	17	17	(1)	(1)	(1)				7,573	7,611	7,080
Sept. 19, 1945	2:55 p. m.	84	0	0	0	(1)	(1)	(1)	10	7.4	120	248	297	397
			9	9	9	(1)	(1)	(1)				407	400	550
			16	17	16	(1)	(1)	(1)				4,366	6,550	6,737
Oct. 10, 1945	2:25 p. m.	78	0	0	0	(1)	(1)	(1)	20	7.5	146	142	99	117
			8	9	8	(1)	(1)	(1)				153	192	142
			14	16	14	(1)	(1)	(1)				1,843	7,493	1,489
Oct. 24, 1945	2:50 p. m.	71	0	0	0	(1)	(1)	(1)	10	7.5	220	601	497	507
			6	8	8	(1)	(1)	(1)				745	703	700
			11	14	14	(1)	(1)	(1)				1,032	2,415	2,411
Nov. 7, 1945	2:43 p. m.	68	0	0	0	(1)	(1)	(1)	30	7.4	44	207	100	354
			6	8	5	(1)	(1)	(1)				531	500	500
			11	15	8	(1)	(1)	(1)				1,652	3,186	8,437
Nov. 21, 1945	1:50 p. m.		0	0	0	(1)	(1)	(1)	20	7.4	96	44	18	33
			7	10	8	(1)	(1)	(1)				46	62	66
			13	18	14	(1)	(1)	(1)				854	5,354	1,293
Dec. 5, 1945	2:35 p. m.	52	0	0	0	41	42	40	80	7.2	44	12	12	12
			6	8	7	41	51	41				12	12	12
			10	14	13	43	46	44				12	12	12
Dec. 19, 1945	2:13 p. m.	48	0	0	0	81	90	80	75	7.2	44	10	11	11
			8	8	8	83	94	85				10	10	11
			4	15	14	95	100	95				10	10	11
Jan. 9, 1946	12:45 p. m.	55	0	0	0	140	140	145	150	6.8	32	8	8	8
			8	10	10	144	158	144				8	8	8
			14	18	18	144	160	160				8	8	8

[1] Less than 25.

D-00011212.0018

TABLE 4.—*Results of laboratory tests—Range 3–A, Mobile River 15.4 miles above Government St.*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples								
						Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
			0	0	0	113	119	111				12	18	18
Jan. 4, 1945	8:50 a. m.		8	9	11	123	136	120	70	7.6	54	10	18	16
			14	17	20	123	135	130				17	19	14
			0	0	0	81	75	81				13	12	12
Jan. 18, 1945	8:40 a. m.		12	9	6	90	93	93	120	7.4	46	14	13	13
			23	16	10	86	97	96				13	12	13
			0	0	0	90	110	90				15	14	14
Jan. 31, 1945	9:40 a. m.		7	7	9	87	124	98	120	7.6	54	16	16	14
			13	13	17	94	123	106				14	15	15
			0	0	0	130	125	125				14	14	14
Feb. 13, 1945	5:15 p. m.	51	7	8	10	137	145	130	140	7.1	40	14	13	10
			13	15	19	135	145	135				15	14	14
			0	0	0	63	66	65				8	8	8
Mar. 6, 1945	5:15 p. m.		8	9	12	64	68	66	130	7.2	38	9	8	8
			15	16	22	69	71	68				8	9	8
			0	0	0	40	54	48				8	8	8
Mar. 20, 1945	4:45 p. m.	66	8	10	12	53	53	53	90	7.2	38	8	8	8
			14	18	22	53	61	60				8	8	8
			0	0	0	91	90	89				7	7	7
Apr. 10, 1945	4:35 p. m.	66	7	9	11	91	90	87	105	7.3	44	7	7	6
			13	16	20	90	97	92				7	7	7
			0	0	0	45	48	49				8	8	8
Apr. 24, 1945	4:20 p. m.	72	7	8	10	50	71	80	80	7.3	50	8	8	8
			12	15	19	56	75	100				8	8	8
			0	0	0	74	76	70				7	7	7
May 9, 1945	3 p. m.		7	8	12	72	75	73	120	7.0	38	7	7	7
			14	16	22	72	78	74				7	7	7
			0	0	0	90	96	76				8	8	8
May 23, 1945	2:30 p. m.	70	7	8	11	93	97	90	90	6.6	30	8	8	8
			13	16	21	96	103	100				8	8	9
			0	0	0	29	28	29				10	10	10
June 6, 1945	3:02 p. m.	85	6	8	10	32	33	33	75	7.2	40	10	10	10
			11	15	19	33	36	34				10	11	11
			0	0	0	24	27	20				11	11	11
June 20, 1945	2:45 p. m.	85	9	8	10	27	27	30	80	7.3	40	11	11	11
			11	15	19	28	29	34				12	11	11
			0	0	0	(1)	(1)	(1)				10	10	11
July 3, 1945	2:25 p. m.	88	9	7	7	(1)	(1)	(1)	55	7.2	48	10	10	10
			17	14	12	(1)	(1)	(1)				10	11	11

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			0	0	0	35	34	35				10	11	11
July 25, 1945	2:48 p. m.	85	8	9	10	35	35	30	100	7.3	40	11	11	11
			15	16	19	35	35	35				11	11	11
			0	0	0	29	28	20				10	10	10
Aug. 8, 1945	2:40 p. m.	87	7	8	10	20	27	28	50	7.5	42	11	11	10
			12	14	18	20	26	27				11	11	10
			0	0	0	(1)	(1)	(1)				26	26	160
Aug. 22, 1945	2:40 p. m.	...	7	8	10	(1)	(1)	(1)	20	7.4	80	32	1,507	038
			13	15	18	(1)	(1)	(1)				1,950	2,223	3,100
			0	0	0	(1)	(1)	(1)				52	55	90
Sept. 5, 1945	2:35 p. m.	86	8	8	10	(1)	(1)	(1)	20	7.5	96	560	532	1,135
			14	14	19	(1)	(1)	(1)				3,150	4,080	4,800
			0	0	0	(1)	(1)	(1)				00	87	106
Sept. 19, 1945	2:35 p. m.	84	6	8	11	(1)	(1)	(1)	15	7.4	50	113	100	543
			11	15	20	(1)	(1)	(1)				1,135	2,109	0,276
			0	0	0	(1)	(1)	(1)				40	28	53
Oct. 10 1945	2:05 p. m.	78	6	7	9	(1)	(1)	(1)	20	7.3	80	51	85	57
			11	15	16	(1)	(1)	(1)				78	213	2,198
			0	0	0	(1)	(1)	(1)				443	479	427
Oct. 24, 1945	2:30 p. m.	71	5	7	9	(1)	(1)	(1)	10	7.5	232	680	568	407
			10	13	17	(1)	(1)	(1)				728	042	1,400
			0	0	0	25—	27	25—				18	21	18
Nov. 7, 1945	2:22 p. m.	68	6	7	9	27	29	31	40	7.3	40	51	37	55
			10	12	19	28	39	36				37	126	4,325
			0	0	0	25—	25—	25—				12	12	13
Nov. 21 1945	1:30 p. m.	...	0	7	10	25—	25	25—	30	7.3	42	12	12	12
			11	15	18	25—	25	25—				14	12	14
			0	0	0	40	39	37				11	11	11
Dec. 5, 1945	2:15 p. m.	52	6	6	9	41	44	38	80	7.1	44	11	11	11
			10	11	16	43	46	42				11	11	11
			0	0	0	78	93	75				10	10	10
Dec. 19, 1945	1:55 p. m.	48	6	12	9	89	100	88	80	7.3	44	10	10	10
			10	22	17	93	104	93				10	10	10

[1] Less than 25.

TABLE 5.—*Results of laboratory tests—Range 3–B, Mobile River 17.1 miles above Government St.*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet): Right	Depth: Center	Depth: Left	Turbidity: Right	Turbidity: Center	Turbidity: Left	Composite samples: Color	Composite: pH	Composite: Total hardness	Chloride in parts per million: Right bank	Chloride: Center	Chloride: Left bank
			0	0	0	123	127	129				16	16	18
Jan. 4, 1945	8:30 a. m.		12	10	7	130	150	133	70	7.6	80	18	15	19
			23	19	13	125	160	145				14	18	12
			0	0	0	80	81	89				15	14	15
Jan. 18, 1945	8:33 a. m.		12	10	8	90	97	90	140	7.4	48	15	15	16
			22	18	14	89	105	96				15	15	15
			0	0	0	87	105	87				15	15	16
Jan. 31, 1945	9:20 a. m.		10	8	6	98	125	96	120	7.7	52	15	15	15
			19	15	11	95	117	103				16	15	16
			0	0	0	125	130	145				13	14	14
Feb. 13, 1945	4:55 p. m.	51	13	9	7	120	139	130	140	7.1	46	14	12	15
			24	17	13	135	140	130				13	18	15
			0	0	0	70	71	72				6	8	8
Mar. 6, 1945	4:56 p. m.	61	14	10	9	71	69	66	135	7.1	40	9	8	8
			26	19	17	72	70	68				8	8	8
			0	0	0	48	57	56				9	5	9
Mar. 20, 1945	4:15 p. m.	66	13	10	8	50	61	58	90	7.3	42	6	9	9
			25	20	15	51	60	55				7	8	8
			0	0	0	88	86	90				7	8	8
Apr. 10, 1945	4:15 p. m.	66	12	11	7	93	94	92	110	7.2	46	7	7	8
			23	21	13	91	96	94				7	7	8
			0	0	0	51	59	63				8	8	7
Apr. 24, 1945	4 p. m.	72	12	10	6	61	60	63	85	7.2	50	6	8	8
			22	19	12	60	92	70				5	5	9
			0	0	0	65	75	74				7	7	7
May 9, 1945	2:45 p. m.		13	11	8	68	78	75	120	7.0	40	8	6	7
			25	21	15	73	79	81				7	7	7
			0	0	0	84	83	95				8	5	8
May 23, 1945	2:10 p. m.		12	11	7	58	95	98	90	7.0	38	8	8	8
			22	21	13	92	108	98				5	8	8
			0	0	0	33	33	28				10	10	10
June 6, 1945	2:45 p. m.	85	13	11	6	33	36	33	75	7.3	42	9	10	10
			24	20	10	36	37	34				10	10	11
			0	0	0	23	26	24				10	11	11
June 20, 1945	2:28 p. m.	85	11	10	6	24	30	27	75	7.3	40	10	10	10
			21	19	10	25	30	28				11	11	11
			0	0	0	[1]	[1]	[1]				10	10	10
July 3, 1945	2:05 p. m.	85	13	10	6	[1]	[1]	[1]	70	7.3	40	10	10	10
			25	19	11	[1]	[1]	[1]				10	10	10

			0	0	0	30	33	35				10	10	10
July 25, 1945	2:28 p. m.	87	12	10	8	31	34	35	80	7.3	42	10	10	10
			23	18	15	33	34	40				10	11	10
			0	0	0	20	29	27				10	10	10
Aug. 8, 1945	2:20 p. m.	86	13	10	8	20	30	28	55	7.3	42	10	10	10
			25	16	15	28	30	34				11	11	10
			0	0	0	([1])	([1])	([1])				10	11	10
Aug. 22, 1945	2:20 p. m.		13	11	6	([1])	([1])	([1])	35	7.4	62	14	12	11
			24	20	11	([1])	([1])	([1])				162	166	16
			0	0	0	([1])	([1])	([1])				16	18	16
Sept. 5, 1945	2:15 p. m.	86	12	10	6	([1])	([1])	([1])	20	7.5	46	16	18	25
			22	19	11	([1])	([1])	([1])				23	25	36
			0	0	0	([1])	([1])	([1])				38	50	48
Sept. 10, 1945	2:15 p. m.	54	12	11	6	([1])	([1])	([1])	12	7.3	58	239	200	78
			23	21	11	([1])	([1])	([1])				2,265	2,245	550
			0	0	0	([1])	([1])	([1])				14	12	11
Oct. 10, 1945	1:50 p. m.	78	10	13	6	([1])	([1])	([1])	20	7.5	38	16	11	10
			16	25	11	([1])	([1])	([1])				62	12	11
			0	0	0	([1])	([1])	([1])				372	390	426
Oct. 24, 1945	2:15 p. m.	71	10	10	5	([1])	([1])	([1])	20	7.5	184	372	390	426
			19	19	9	26	([1])	([1])				727	550	426
			0	0	0	25—	25—	25—				11	12	11
Nov. 7, 1945	2:05 p. m.		13	9	7	25—	27	25—	40	7.3	36	11	11	11
			24	17	12	25	30	26				12	11	10
			0	0	0	([1])	([1])	([1])				12	12	12
Nov. 21, 1945	1:10 p. m.		11	9	7	([1])	([1])	([1])	30	7.3	40	12	12	11
			21	17	12	([1])	([1])	([1])				12	13	11
			0	0	0	42	41	38				10	10	11
Dec. 5, 1945	2 p. m.	52	9	9	6	41	42	39	60	7.1	42	10	10	10
			17	17	10	41	46	43				10	10	11
			0	0	0	80	89	80				10	10	10
Dec. 19, 1945	1:30 p. m.	48	11	10	6	82	102	92	70	7.1	44	10	10	10
			20	19	10	80	105	90				9	10	9
			0	0	0	149	160	150				8	8	8
Jan. 9, 1946	12:30 p. m.	56	12	11	8	147	161	160	150	7.0	34	8	8	8
			22	20	14	150	167	160				8	8	8

[1] Less than 25.

D-00011212.0022

TABLE 6.—*Results of laboratory tests—Range 4, Mobile River 20.5 miles above Government St.*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples								
						Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
Nov. 9, 1944	12:15 p. m.	64	...	0	...	...	...	...	...	...	...	...	30	...
			...	20	...	...	...	...				...	32	...
			...	38	...	...	...	...				...	2,600	...
Nov. 28, 1944	5 p. m.	54	0	...	0	35	...	43	50	7.0	34	16	...	18
			10	...	19	45	...	...				18	...	18
			30	...	36	73	...	62				19	...	18
Dec. 5, 1944	4:45 p. m.	...	0	...	0	...	...	...	...	7.2	34	9	...	10
			15	...	20	...	...	...				11	...	13
			29	...	39	...	...	...				12	...	12
Jan. 3, 1945	4:55 p. m.	...	0	0	0	100	95	90	70	7.6	64	16	19	14
			13	18	20	110	112	108				14	16	15
			24	34	39	120	117	150				16	14	13
Jan. 17, 1945	4:10 p. m.	...	0	0	0	97	94	103	140	7.7	54	12	12	14
			12	18	19	100	102	104				11	13	15
			23	35	36	105	107	106				12	14	13
Jan. 30, 1945	5:58 p. m.	...	0	0	0	100	97	80	120	7.6	52	13	14	17
			13	18	16	100	130	116				14	17	17
			24	34	30	111	120	125				14	15	16
Feb. 13, 1945	4:30 p. m.	51	0	0	0	130	145	120	135	7.2	46	14	14	13
			12	24	17	130	140	130				13	13	13
			23	47	32	135	137	145				13	13	14
Mar. 6, 1945	4:25 p. m.	61	0	0	0	63	65	70	130	7.0	44	8	9	8
			19	20	19	60	67	69				9	8	8
			36	39	37	66	67	68				8	8	8
Mar. 20, 1945	4 p. m.	66	0	6	0	51	50	55	90	7.2	42	8	8	8
			14	19	17	53	54	52				8	8	7
			27	37	33	54	56	62				9	8	8
Apr. 10, 1945	3:45 p. m.	60	0	0	0	93	93	89	105	7.3	46	7	7	7
			12	18	17	94	92	91				7	7	8
			23	34	33	93	95	98				8	7	8
Apr. 24, 1945	3:30 p. m.	72	0	0	0	65	50	45	80	7.3	52	8	8	8
			15	20	17	70	73	80				8	8	8
			29	38	33	70	81	90				8	8	8
May 9, 1945	2:14 p. m.	...	0	0	0	70	71	68	120	7.0	38	7	7	7
			14	20	18	72	74	77				7	7	7
			26	30	34	75	75	75				6	7	8
May 23, 1945	1:50 p. m.	70	0	0	0	90	83	87	90	7.2	38	8	8	8
			13	19	17	85	93	98				8	9	8
			24	36	32	91	98	103				8	8	9

June 6, 1945	2:10 p. m.	85	0	0	0	32	30	33	75	7.3	42	11	10	10
			13	18	17	38	42	39				10	9	10
			24	35	33	37	30	41				10	10	10
June 20, 1945	1:55 p. m.	85	0	0	0	26	23	24	75	7.3	42	10	11	12
			12	19	14	27	27	31				11	11	12
			23	37	27	29	29	35				11	12	11
July 3, 1945	1:35 p. m.	87	0	0	0	24—	24—	24—	55	7.3	48	10	10	10
			12	19	15	24	26	24				10	10	10
			23	36	20	24—	24	25				10	11	10
July 25, 1945	1:52 p. m.	87	0	0	0	35	31	32	80	7.3	44	10	10	9
			13	19	16	35	33	45				9	10	10
			24	37	30	35	38	36				9	10	10
Aug. 8, 1945	1:50 p. m.		0	0	0	28	27	26	60	7.5	42	10	10	10
			13	18	20	28	28	46				10	10	10
			24	35	38	32	31	35				9	10	9
Aug 22, 1945	1:50 p. m.		0	0	0	(1)	(1)	(1)	30	7.0	44	10	10	10
			14	19	16	(1)	(1)	(1)				10	10	10
			20	36	30	(1)	(1)	(1)				10	11	10
Sept. 5, 1945	1:45 p. m.	87	0	0	0	(1)	(1)	(1)	30	7.5	40	10	10	20
			14	19	14	(1)	(1)	(1)				12	12	20
			26	37	27	(1)	(1)	(1)				12	12	20
Sept. 19, 1945	1:40 p. m.	84	0	0	0	(1)	(1)	(1)	20	7.3	40	10	10	10
			12	19	10	(1)	(1)	(1)				10	10	11
			23	37	30	(1)	(1)	(1)				10	10	10
Oct. 10, 1945	1:20 p. m.	77	0	0	0	(1)	(1)	(1)	30	7.4	38	11	11	10
			12	18	14	(1)	(1)	(1)				11	11	10
			23	34	27	(1)	(1)	(1)				11	11	11
Oct. 24, 1945	1:40 p. m.	71	0	0	0	(1)	(1)	(1)	20	7.4	92	40	102	58
			12	18	16	(1)	(1)	(1)				69	54	60
			22	35	30	(1)	(1)	(1)				191	268	90
Nov. 7, 1945	1:30 p. m.	68	0	0	0	25	25—	25—	45	7.3	38	11	10	10
			12	18	13	25	27	28				10	10	11
			22	34	25	27	27	31				10	11	10
Nov. 21, 1945	12:40 p. m.		0	0	0	25—	25—	25—	40	7.3	40	12	12	13
			12	18	13	25—	25—	25—				13	11	13
			23	35	25	25—	25	26				13	12	12
Dec. 5, 1945	1:30 p. m.	52	0	0	0	43	50	48	80	7.1	44	10	10	11
			11	18	14	45	48	54				10	10	10
			21	34	27	48	48	50				10	10	10
Dec. 19, 1945	1:20 p. m.	47	0	0	0	78	73	70	80	7.1	44	9	9	10
			11	14	14	84	92	98				10	9	10
			21	27	27	90	91	112				9	9	9
Jan. 9, 1946	12 m.	55	0	0	0	147	150	159	150	7.0	30	8	8	8
			13	17	16	165	163	168				8	8	8
			25	32	31	158	163	165				8	8	8

[1] Less than 25.

D-00011212.0024

TABLE 7.—*Results of laboratory tests—Range 5, Mobile River 26.2 miles above Government St.*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples									
						Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
			…	0	…	…	…	…				…	11	…
Nov. 9, 1944	11:35 a. m.	64	…	18	…	…	…	…	…	…	…	…	12	…
			…	35	…	…	…	…				…	12	…
			0	…	0	50	…	42				16	…	17
Nov. 28, 1944	4:20 p. m.	54	19	…	16	60	…	74	50	7.2	30	17	…	17
			36	…	30	70	…	65				17	…	17
			0	…	0	…	…	…				7	…	8
Dec. 5, 1944	3:55 p. m.	…	20	…	18	…	…	…	…	7.2	46	9	…	12
			38	…	34	…	…	…				8	…	8
			0	0	0	135	134	126				10	16	10
Jan. 3, 1945	4:05 p. m.	…	19	18	15	146	122	155	70	7.4	58	16	17	18
			36	34	29	150	156	175				16	18	17
			0	0	0	93	97	95				12	11	11
Jan. 17, 1945	3:42 p. m.	…	19	18	16	96	100	97	120	7.5	52	12	12	13
			36	34	30	98	99	104				12	11	12
			0	0	0	95	100	110				15	15	14
Jan. 30, 1945	5:15 p. m.	…	17	10	15	104	112	107	120	7.4	44	14	15	15
			32	31	29	101	108	117				14	14	12
			0	0	0	125	130	125				13	15	14
Feb. 13, 1945	3:50 p. m.	52	18	18	10	135	135	122	135	7.3	40	13	13	14
			35	35	30	130	125	135				14	14	14
			0	0	0	65	61	67				8	8	8
Mar. 6, 1945	3:35 p. m.	61	19	20	16	63	62	67	130	7.0	40	9	8	8
			37	39	31	65	67	67				8	8	8
			0	0	0	50	46	55				8	8	8
Mar. 20, 1945	3:12 p. m.	68	22	21	14	50	55	50	90	7.2	40	8	8	8
			43	41	27	49	52	56				9	8	8
			0	0	0	90	95	95				7	7	7
Apr. 10, 1945	3:10 p. m.	66	19	20	14	90	90	99	105	7.4	44	7	7	7
			37	38	27	96	98	97				8	7	7
			0	0	0	64	68	63				9	8	8
Apr. 24, 1945	2:55 p. m.	…	20	19	15	75	80	85	80	7.2	52	8	8	8
			39	37	29	85	90	90				8	8	8
			0	0	0	76	75	76				7	7	6
May 9, 1945	1:35 p. m.	…	20	19	16	78	76	75	120	7.0	42	7	7	6
			39	37	30	78	75	75				7	7	6
			0	0	0	95	95	92				8	8	8
May 23, 1945	1:03 p. m.	…	18	20	16	92	95	99	90	7.3	36	9	8	8
			34	38	31	95	100	100				8	8	8

D-00011212.0025

June 6, 1945	1:25 p. m.	85	0	0	0	42	42	40	75	6.8	42	9	10	10
			17	19	12	42	42	48				9	10	9
			31	36	23	43	42	46				9	11	10
June 20, 1945	1:10 p. m.	84	0	0	0	32	30	32	75	7.4	42	12	10	11
			16	18	15	32	35	36				11	10	10
			32	34	29	42	35	38				11	10	10
July 3, 1945	12:20 p. m.	87	0	0	0	24—	24—	24—	50	7.3	48	9	10	0
			13	18	8	24—	24—	25				10	10	10
			24	35	14	25	27	27				10	10	10
July 25, 1945	1:20 p. m.	96	0	0	0	34	34	35	80	7.3	14	0	10	9
			18	18	15	33	36	45				0	0	9
			35	34	28	42	35	59				10	9	9
Aug. 8, 1945	1:05 p. m.	88	0	0	0	34	34	34	70	7.2	40	10	10	0
			17	20	13	94	37	38				10	10	0
			32	38	25	44	37	43				10	10	0
Aug. 22, 1945	1:05 p. m.		0	0	0	(1)	(1)	(1)	30	7.2	44	11	10	10
			16	17	13	(1)	(1)	(1)				11	10	10
			30	33	25	(1)	(1)	(1)				10	10	10
Sept. 5, 1945	12:55 p. m.	56	0	0	0	25—	25—	25—	30	7.5	38	10	10	10
			15	18	13	25—	25—	27				11	10	10
			29	34	25	27	25	28				10	10	10
Sept. 19, 1945	12:55 p. m.	64	0	0	0	(1)	(1)	(1)	20	7.3	44	10	10	10
			15	18	12	(1)	(1)	(1)				11	10	10
			28	34	23	(1)	(1)	(1)				10	10	10
Oct. 10, 1945	12:35 p. m.	75	0	0	0	29	27	27	35	7.3	34	10	10	11
			16	17	12	29	29	27				10	10	10
			31	33	23	30	32	29				10	10	10
Oct. 24, 1945	12:55 p. m.	70	0	0	0	27	25	20	30	7.5	38	10	10	10
			16	16	16	29	27	35				10	10	10
			31	31	30	32	29	35				10	10	10
Nov. 7, 1945	12:50 p. m.	67	0	0	0	27	25—	25—	40	7.3	38	11	10	11
			16	16	15	27	28	30				11	10	11
			31	30	20	28	31	36				11	10	11
Nov. 21, 1945	12 N.		0	0	0	28	25	27	50	7.3	38	12	12	13
			18	19	12	30	29	35				12	12	13
			34	37	23	70	32	90				13	13	12
Dec. 5, 1945	12:50 p. m.	52	0	0	0	47	46	50	80	7.2	44	10	10	11
			16	17	13	48	50	60				10	10	11
			30	32	24	51	54	66				0	10	10
Dec. 19, 1945	12:40 p. m.	47	0	0	0	83	83	90	75	7.0	44	10	10	9
			17	18	12	90	90	105				10	9	9
			33	34	23	99	99	97				9	9	9
Jan. 9, 1946	11:20 a. m.	55	0	0	0	165	170	180	150	7.1	40	6	8	8
			19	20	13	170	176	165				6	8	8
			36	39	25	180	170	188				8	6	8

[1] Less than 25.

TABLE 8.—*Results of laboratory tests—Range 6, Mobile River 34.7 miles above Government St.*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples								
						Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
			...	0	...	...	...	...				...	12	...
Nov. 9, 1944	10:35 p. m.	62	...	10	...	...	...	...	...	...	...	...	12	...
			...	37	...	...	...	...				...	11	...
			0	...	0	102	...	96				16	...	15
Nov. 28, 1944	3:20 p. m.	54	18	...	10	116	...	135	75	7.0	38	13	...	15
			34	...	10	120	...	147				16	...	16
			0	...	0	...	...	...				8	...	8
Dec. 5, 1944	3 p. m.	...	22	...	11	...	...	...	...	7.2	44	11	...	11
			43	...	20	...	...	...				8	...	7
			0	...	0	150	...	162				16	...	16
Jan. 3, 1945	3:10 p. m.	...	23	...	13	175	...	205	70	7.0	64	15	...	16
			44	...	24	170	...	260				14	...	18
			0	...	0	83	...	93				12	...	12
Jan. 17, 1945	2:50 p. m.	...	22	...	12	95	...	97	120	7.4	52	12	...	11
			42	...	22	100	...	98				12	...	11
			0	...	6	103	...	95				14	...	14
Jan. 30, 1945	4:15 p. m.	...	18	...	10	110	...	103	120	7.3	46	15	...	14
			34	...	19	103	...	110				14	...	17
			0	...	0	118	...	123				14	...	14
Feb. 13, 1945	2:50 p. m.	52	21	...	12	128	...	130	135	7.1	44	15	...	15
			42	...	22	134	...	129				14	...	15
			0	...	0	50	...	65				9	...	9
Mar. 6, 1945	2:40 p. m.	61	27	...	14	61	...	62	130	7.2	38	10	...	8
			54	...	27	62	...	65				9	...	9
			0	...	0	49	...	53				8	...	8
Mar. 20, 1945	2:15 p. m.	66	24	...	11	52	...	50	90	7.3	42	6	...	8
			47	...	20	53	...	55				8	...	8
			0	...	9	90	...	85				7	...	8
Apr. 10, 1945	2:10 p. m.	66	25	...	10	89	...	92	105	7.2	44	8	...	7
			49	...	18	90	...	95				7	...	7
			0	...	6	75	...	73				7	...	7
Apr. 24, 1945	1:50 p. m.	72	18	...	11	73	...	100	30	7.4	50	8	...	8
			30	...	21	80	...	110				8	...	8
			0	...	0	75	...	79				7	...	6
May 9, 1945	12:05 p. m.	...	25	...	12	80	...	80	120	7.1	40	7	...	7
			48	...	22	80	...	80				6	...	6
			0	...	0	85	...	90				8	...	7
May 23, 1945	12:05 p. m.	70	23	...	10	93	...	96	90	7.2	38	8	...	8
			44	...	16	95	...	98				8	...	8

D-00011212.0027

June 6, 1945	12:20 p. m.	----------	0	----------	0	45	----------	43	75	7.2	38	10	----------	9
			20	----------	9	47	----------	48				9	----------	10
			38	----------	17	49	----------	53				10	----------	10
June 20, 1945	12:10 p. m.	84	0	----------	0	38	----------	43	75	7.3	42	11	----------	11
			21	----------	8	44	----------	58				12	----------	12
			40	----------	15	43	----------	72				11	----------	11
July 3, 1945	11:45 a. m.	87	0	----------	0	24—	----------	24—	40	7.3	40	10	----------	10
			20	----------	11	24	----------	33				10	----------	10
			39	----------	20	24	----------	38				10	----------	10
July 25, 1945	12 n.	86	0	----------	0	36	----------	30	60	7.4	46	9	----------	10
			20	----------	10	37	----------	42				10	----------	9
			38	----------	10	37	----------	42				10	----------	10
Aug. 8, 1945	12:05 p. m.	88	0	----------	0	33	----------	34	05	7.5	38	9	----------	9
			10	----------	9	37	----------	41				10	----------	10
			36	----------	17	30	----------	52				9	----------	9
Aug. 22, 1945	12 n.	----------	0	----------	0	(1)	----------	(1)	30	7.0	42	10	----------	11
			18	----------	8	(1)	----------	(1)				10	----------	10
			35	----------	14	(1)	----------	(1)				10	----------	10
Sept. 5, 1945	11:45 a. m.	85	0	----------	0	25	----------	25—	30	7.5	36	11	----------	10
			10	----------	7	27	----------	25				11	----------	10
			37	----------	13	34	----------	28				12	----------	10
Sept. 19, 1945	11:50 a. m.	84	0	----------	0	25	----------	25	20	7.3	30	10	----------	10
			21	----------	7	26	----------	28				10	----------	10
			41	----------	13	25	----------	25				10	----------	10
Oct. 10, 1945	11:35 a. m.	75	0	----------	0	38	----------	38	40	7.3	38	13	----------	12
			20	----------	9	38	----------	41				14	----------	12
			39	----------	16	75	----------	50				12	----------	11
Oct. 24, 1945	11:50 a. m.	69	0	----------	0	31	----------	32	40	7.3	38	11	----------	11
			23	----------	8	33	----------	36				11	----------	11
			45	----------	14	32	----------	39				10	----------	11
Nov. 7, 1945	11:45 a. m.	67	0	----------	0	25—	----------	25—	40	7.3	40	11	----------	10
			17	----------	10	25—	----------	32				11	----------	10
			33	----------	10	28	----------	36				10	----------	11
Nov. 21, 1945	11 a. m.	----------	0	----------	0	35	----------	35	50	7.3	38	14	----------	12
			25	----------	8	39	----------	48				14	----------	12
			48	----------	14	38	----------	53				13	----------	14
Dec. 5, 1945	11:50 a. m.	52	0	----------	0	46	----------	50	80	7.2	44	10	----------	11
			18	----------	10	51	----------	58				11	----------	10
			35	----------	19	51	----------	60				11	----------	10
Dec. 19, 1945	11:40 a. m.	47	0	----------	0	94	----------	95	80	7.3	44	9	----------	9
			19	----------	10	95	----------	110				9	----------	9
			36	----------	10	95	----------	110				9	----------	9
Jan. 9, 1946	10:25 a. m.	55	0	----------	0	185	----------	180	150	7.1	40	8	----------	8
			21	----------	12	180	----------	200				8	----------	8
			41	----------	22	160	----------	210				----------	----------	8

[1] Less than 25

D-00011212.0028

TABLE 9.—*Results of laboratory tests—Range 7, Tensaw River 1 mile downstream from mile 39 Mobile River*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples									
						Turbidity			Composite samples			Chloride in parts per million			
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
Nov. 9, 1944	9:35 a. m.	62	----	0	----	----	----	----	----	----	----	----	11	----
			----	0	----	----	----	----				----	11	----
			----	18	----	----	----	----				----	11	----
Nov. 28, 1944	2:35 p. m.	54	0	----	0	150	----	158	85	7.3	46	13	----	14
			6	----	11	150	----	175				12	----	13
			11	----	21	175	----	238				10	----	13
Dec. 5, 1944	2:15 p. m.	----	0	----	0	----	----	----	----	7.2	38	8	----	8
			5	----	11	----	----	----				10	----	10
			9	----	21	----	----	----				7	----	10
Jan. 3, 1945	2:20 p. m.	----	0	----	0	175	----	165	70	7.4	56	15	----	17
			6	----	12	200	----	205				15	----	16
			10	----	23	215	----	260				14	----	15
Jan. 17, 1945	do.	----	0	----	0	90	----	90	120	7.5	46	11	----	12
			7	----	15	90	----	93				12	----	13
			12	----	25	95	----	93				11	----	11
Jan. 30, 1945	3:40 p. m.	----	0	----	0	106	----	83	125	7.5	52	15	----	14
			6	----	13	125	----	107				15	----	14
			10	----	25	125	----	110				15	----	16
Feb. 13, 1945	2:20 p. m.	52	0	----	0	116	----	113	120	7.0	46	14	----	14
			8	----	15	115	----	116				13	----	14
			14	----	29	119	----	115				14	----	14
Mar. 6, 1945	1:50 p. m.	61	0	----	0	70	----	71	130	7.2	40	9	----	9
			14	----	19	73	----	70				8	----	8
			27	----	36	70	----	80				9	----	9
Mar. 20, 1945	1:30 p. m.	66	0	----	0	57	----	66	90	7.4	40	9	----	9
			9	----	18	60	----	65				10	----	8
			17	----	34	59	----	68				9	----	8
Apr. 10, 1945	1:35 p. m.	66	0	----	0	85	----	83	100	7.3	44	8	----	8
			9	----	17	89	----	85				9	----	8
			17	----	33	90	----	86				8	----	7
Apr. 24, 1945	1:05 p. m.	72	0	----	0	70	----	78	80	7.0	50	7	----	7
			6	----	14	90	----	100				7	----	7
			10	----	20	100	----	101				8	----	7
May 9, 1945	11:25 a. m.	----	0	----	0	73	----	75	120	7.0	42	6	----	7
			8	----	17	80	----	79				7	----	6
			14	----	32	81	----	80				6	----	6
May 23, 1945	11:25 a. m.	70	0	----	0	86	----	90	100	7.2	36	7	----	7
			7	----	17	92	----	90				7	----	7
			13	----	32	92	----	92				7	----	7

June 6, 1945	11:35 a. m.	83	0	-----	0	43	-----	50	75	7.4	40	10	-----	9
			5	-----	15	48	-----	54				10	-----	9
			8	-----	28	55	-----	50				10	-----	9
June 20, 1945	11:25 a. m.	84	0	-----	0	42	-----	35	80	7.3	40	12	-----	11
			5	-----	16	42	-----	42				11	-----	12
			9	-----	30	44	-----	43				12	-----	12
July 3, 1945	10:05 a. m.	78	0	-----	0	27	-----	25	45	7.3	50	10	-----	10
			6	-----	14	29	-----	31				10	-----	10
			10	-----	27	28	-----	33				11	-----	11
July 25, 1945	11:30 a. m.	87	0	-----	0	33	-----	29	60	7.2	40	9	-----	9
			6	-----	13	36	-----	38				8	-----	9
			11	-----	24	39	-----	38				9	-----	9
Aug. 8, 1945	11:20 a. m.	88	0	-----	0	43	-----	35	70	7.5	40	9	-----	10
			6	-----	13	44	-----	50				10	-----	10
			11	-----	25	45	-----	50				10	-----	9
Aug. 22, 1945	do.	-----	0	-----	0	(1)	-----	(1)	20	7.3	42	9	-----	10
			7	-----	13	(1)	-----	(1)				10	-----	10
			12	-----	25	(1)	-----	(1)				9	-----	10
Sept. 5, 1945	11:05 a. m.	85	0	-----	0	25—	-----	25	30	7.6	36	10	-----	10
			5	-----	13	25—	-----	27				10	-----	10
			8	-----	24	25	-----	28				10	-----	10
Sept. 19, 1945	do.	83	0	-----	0	25—	-----	25—	20	7.3	32	10	-----	10
			6	-----	13	27	-----	26				10	-----	10
			10	-----	25	25	-----	30				9	-----	9
Oct. 10, 1945	10:50 a. m.	74	0	-----	0	37	-----	38	40	7.3	38	12	-----	12
			6	-----	12	38	-----	40				12	-----	13
			10	-----	23	30	-----	41				12	-----	12
Oct. 24, 1945	11:10 a. m.	69	0	-----	0	31	-----	29	40	7.3	32	10	-----	10
			5	-----	13	33	-----	31				10	-----	9
			9	-----	24	35	-----	38				10	-----	10
Nov. 7, 1945	11 a. m.	67	0	-----	0	25—	-----	25—	35	7.3	42	11	-----	10
			5	-----	12	25	-----	29				11	-----	11
			8	-----	23	28	-----	29				11	-----	12
Nov. 21, 1945	10:20 a. m.	-----	0	-----	0	39	-----	38	70	7.3	40	13	-----	13
			5	-----	15	40	-----	41				13	-----	13
			9	-----	28	42	-----	43				13	-----	13
Dec. 5, 1945	11:10 a. m.	52	0	-----	0	50	-----	46	80	7.1	44	11	-----	11
			4	-----	12	52	-----	55				11	-----	11
			7	-----	23	54	-----	58				12	-----	11
Dec. 19, 1945	11 a. m.	47	0	-----	0	103	-----	120	80	7.3	40	10	-----	9
			5	-----	14	105	-----	130				10	-----	10
			9	-----	27	119	-----	140				9	-----	10

[1] Less than 25.

D-00011212.0030

TABLE 10.—*Results of laboratory tests—range 8, Mobile River 40 miles above Government St.*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples								
						Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
Nov. 9, 1944	9:20 a. m.	62	------	0	------	------	------	------	------	------	------	------	11	------
			------	16	------	------	------	------				------	12	------
			------	31	------	------	------	------				------	11	------
Nov. 28, 1944	2:20 p. m.	54	0	------	0	145	------	164	90	7.2	34	14	------	12
			23	------	11	152	------	228				15	------	13
			44	------	21	150	------	270				13	------	13
Dec. 5, 1944	2 p. m.	------	0	------	0	------	------	------	------	7.2	38	8	------	0
			25	------	11	------	------	------				10	------	10
			50	------	21	------	------	------				7	------	7
Jan. 3, 1945	2:10 p. m.	------	0	------	0	160	------	140	70	7.4	60	12	------	14
			23	------	13	160	------	210				12	------	12
			44	------	24	175	------	265				14	------	14
Jan. 17, 1945	2 p. m.	------	0	------	0	95	------	70	120	7.4	52	10	------	11
			19	------	11	99	------	78				11	------	10
			37	------	21	95	------	82				11	------	11
Jan. 30, 1945	3:25 p. m.	------	0	------	0	105	------	97	120	7.0	48	14	------	14
			17	------	8	116	------	108				14	------	15
			32	------	15	112	------	119				16	------	14
Feb. 19, 1945	1:55 p. m.	53	0	------	0	123	------	90	110	7.1	50	14	------	14
			17	------	11	122	------	105				15	------	13
			32	------	21	118	------	111				14	------	13
Mar. 6, 1945	1:35 p. m.	61	0	------	0	63	------	70	135	6.9	40	9	------	9
			21	------	13	65	------	75				10	------	10
			41	------	25	71	------	80				9	------	9
Mar. 20, 1945	1:20 p. m.	66	0	------	0	50	------	71	90	7.3	50	10	------	8
			19	------	6	48	------	78				10	------	9
			37	------	10	51	------	80				9	------	8
Apr. 10, 1945	1:15 p. m.	66	0	------	0	85	------	77	100	7.3	44	9	------	8
			19	------	6	87	------	76				8	------	8
			37	------	11	94	------	82				8	------	8
Apr. 24, 1945	12:50 p. m.	72	0	------	0	75	------	73	80	7.1	52	8	------	8
			19	------	8	78	------	105				8	------	7
			36	------	15	80	------	120				8	------	7
May 9, 1945	11:05 a. m.	------	0	------	0	75	------	77	120	7.0	40	8	------	8
			16	------	10	77	------	80				8	------	8
			31	------	18	81	------	80				6	------	7
May 23, 1945	11:10 a. m.	70	0	------	0	87	------	80	100	7.1	38	7	------	7
			17	------	9	80	------	93				7	------	8
			31	------	17	90	------	89				7	------	7

D-00011212.0031

June 6, 1945	11:15 a. m.	82	0	----------	0	45	----------	47	75	7.0	42	10	----------	9
			15	----------	8	47	----------	58				10	----------	0
			29	----------	15	47	----------	57				10	----------	9
June 20, 1945	11:10 a. m.	84	0	----------	0	40	----------	40	60	7.0	44	11	----------	12
			10	----------	10	42	----------	58				11	----------	11
			31	----------	18	40	----------	04				12	----------	12
July 3, 1945	10:50 a. m.	87	0	----------	0	26	----------	21	40	7.3	50	10	----------	10
			14	----------	11	28	----------	31				10	----------	10
			26	----------	20	33	----------	32				10	----------	10
July 25, 1945	11 a. m.	86	0	----------	0	40	----------	30	70	7.4	46	8	----------	8
			16	----------	11	43	----------	45				10	----------	8
			30	----------	20	44	----------	48				10	----------	9
Aug. 8, 1945	11:05 a. m.	88	0	----------	0	42	----------	40	70	7.0	40	10	----------	10
			14	----------	0	43	----------	60				9	----------	9
			27	----------	17	44	----------	61				9	----------	9
Aug. 22, 1945	11 a. m.	----------	0	----------	0	(1)	----------	(1)	30	7.3	46	9	----------	10
			15	----------	0	(1)	----------	(1)				10	----------	10
			29	----------	17	(1)	----------	(1)				10	----------	10
Sept. 5, 1945	10:50 a. m.	86	0	----------	0	25	----------	25	30	7.5	30	10	----------	9
			15	----------	7	25	----------	31				11	----------	10
			28	----------	13	27	----------	37				10	----------	10
Sept. 10, 1945	10:50 a. m.	83	0	----------	0	25	----------	25	20	7.3	30	9	----------	10
			16	----------	8	30	----------	28				10	----------	10
			31	----------	15	30	----------	31				10	----------	10
Oct. 10, 1945	10:35 a. m.	74	0	----------	0	33	----------	40	40	7.3	40	13	----------	12
			13	----------	8	36	----------	45				12	----------	12
			24	----------	14	37	----------	50				11	----------	12
Oct. 24, 1945	10:55 a. m.	68	0	----------	0	30	----------	30	40	7.3	32	11	----------	10
			17	----------	10	33	----------	37				10	----------	11
			31	----------	18	34	----------	38				10	----------	11
Nov. 7, 1945	10:50 a. m.	07	0	----------	0	25	----------	24	40	7.3	40	12	----------	11
			17	----------	8	25	----------	29				12	----------	11
			31	----------	14	25	----------	31				11	----------	10
Nov. 21, 1945	10 a. m.	----------	0	----------	0	35	----------	34	50	7.3	40	12	----------	10
			14	----------	7	36	----------	40				11	----------	10
			26	----------	13	42	----------	41				12	----------	10
Dec. 5, 1945	10:55 a. m.	52	0	----------	0	50	----------	39	80	7.2	44	11	----------	10
			13	----------	7	50	----------	47				10	----------	10
			24	----------	12	50	----------	49				11	----------	11
Dec. 19, 1945	10:46 a. m.	47	0	----------	0	103	----------	101	80	7.2	40	8	----------	9
			16	----------	8	100	----------	133				10	----------	8
			31	----------	14	110	----------	175				10	----------	8
Jan. 9, 1946	9:55 a. m.	55	0	----------	0	200	----------	100	210	7.2	40	8	----------	8
			19	----------	11	200	----------	200				8	----------	8
			37	----------	20	105	----------	107				8	----------	8

[1] Less than 25.

TABLE 11.—*Results of laboratory tests—Range 9, Tombigbee River 2 miles above mouth*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples								
						Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
			...	0	...	...	...	...				...	13	...
Nov. 9, 1944	8:30 a. m.	62	...	12	...	...	...	...	...	...	...	...	11	...
			...	24	...	...	...	...				...	13	...
			0	...	0	103	...	120				13	...	15
Nov. 28, 1944	1:35 p. m.	54	14	...	12	118	...	128	80	7.4	46	18	...	14
			26	...	22	115	...	150				15	...	14
			0	...	0	...	...	...				10	...	9
Dec. 5, 1944	1:10 p. m.	...	13	...	12	...	...	...	...	7.2	50	10	...	11
			24	...	22	...	...	...				9	...	9
			0	...	0	230	...	245				12	...	13
Jan. 3, 1945	1:25 p. m.	...	14	...	13	250	...	260	70	7.2	68	11	...	15
			29	...	24	250	...	280				14	...	10
			0	...	0	96	...	97				12	...	11
Jan. 17, 1945	1:20 p. m.	...	15	...	13	99	...	98	140	7.6	50	12	...	10
			29	...	25	95	...	99				12	...	11
			0	...	0	110	...	110				14	...	14
Jan. 30, 1945	2:35 p. m.	...	14	...	11	119	...	115	120	7.2	54	14	...	14
			27	...	21	110	...	120				14	...	14
			0	...	0	121	...	128				13	...	13
Feb. 13, 1945	1:15 p. m.	53	16	...	13	115	...	130	110	7.3	46	13	...	14
			31	...	24	123	...	135				14	...	13
			0	...	0	67	...	67				10	...	9
Mar. 6, 1945	12:45 p. m.	61	18	...	14	60	...	70	135	7.3	40	10	...	9
			36	...	27	67	...	73				9	...	9
			0	...	0	43	...	43				10	...	9
Mar. 20, 1945	12:35 p. m.	68	18	...	14	45	...	46	90	7.3	48	10	...	10
			35	...	26	44	...	46				9	...	10
			0	...	0	94	...	90				8	...	8
Apr. 10, 1945	do.	66	16	...	14	96	...	94	120	7.2	40	8	...	8
			34	...	27	93	...	96				8	...	8
			0	...	0	80	...	72				8	...	8
Apr. 24, 1945	12:10 p. m.	71	14	...	11	78	...	100	90	7.0	46	8	...	9
			27	...	22	90	...	108				8	...	8
			0	...	0	82	...	80				6	...	6
May 9, 1945	10:20 p. m.	...	17	...	13	85	...	80	120	7.1	42	6	...	7
			33	...	25	82	...	83				7	...	7
			0	...	0	92	...	92				6	...	7
May 23, 1945	10:30 a. m.	70	17	...	13	93	...	95	100	7.0	38	6	...	6
			33	...	25	87	...	101				6	...	6

June 6, 1945	do	52	0		0	46		42	60	7.5	46	9		11
			13		10	46		40				11		10
			25		19	48		40				10		10
June 20, 1945	10:20 a. m.	83	0		0	39		37	50	7.4	52	12		12
			13		11	40		52				13		13
			24		20	45		63				14		13
July 3, 1945	10 a. m.	87	0		0	32		32	45	7.3	52	11		10
			13		10	34		36				10		11
			24		19	35		40				11		11
July 25, 1945	10:12 a. m.	86	0		0	51		52	60	7.4	50	7		8
			13		10	55		62				8		13
			25		19	52		62				12		11
Aug. 8, 1945	10:20 a. m.	98	0		0	47		47	70	7.3	38	9		9
			13		10	52		53				10		9
			24		19	47		58				9		10
Aug. 22, 1945	10:15 a. m.		0		0	(1)		(1)	30	7.3	46	10		10
			13		11	(1)		(1)				9		10
			25		21	(1)		(1)				9		10
Sept. 5, 1945	9:55 a. m.	85	0		0	25		26	30	7.5	42	10		10
			11		10	25		27				10		10
			21		19	28		30				11		10
Sept. 19, 1945	10 a. m.		0		0	27½		27½	35	7.3	34	10		10
			13		10	35		32				10		9
			25		19	30		34				10		9
Oct. 10, 1945	9:45 a. m.	74	0		0	48		43	40	7.3	40	13		13
			13		10	43		50				17		13
			25		18	40		50				13		14
Oct. 24, 1945	10:10 a. m.	68	0		0	35		40	40	7.3	40	13		13
			13		10	39		44				14		12
			24		19	42		47				13		13
Nov. 7, 1945	10 a. m.	66½	0		0	28		25	40	7.3	35	10		9
			12		10	32		34				12		11
			23		19	31		41				10		10
Nov. 21, 1945	9:15 a. m.		0		0	45		47	90	7.3	42	13		14
			14		7	48		50				13		14
			20		15	50		55				13		13
Dec. 5, 1945	10:10 a. m.	52	0		0	45		51	100	7.0	44	11		11
			11		9	52		55				11		10
			21		17	55		62				10		11
Dec. 19, 1945	10 a. m.	46	0		0	110		140	80	7.2	52	9		9
			14		10	120		135				8		9
			27		19	125		145				10		9

[1] Less than 25.

TABLE 12.—*Results of laboratory tests—Range 10, Alabama River 2.7 miles above mouth*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples: Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
			------	0	------	------	------	------				------	9	------
Nov. 9, 1944	7:50 a. m.	62	------	8	------	------	------	------	------	------	------	------	9	------
			------	15	------	------	------	------				------	9	------
			0	------	0	205	------	205				35	------	18
Nov. 28, 1944	1 p. m.	54	10	------	5	238	------	235	100	7.4	52	20	------	11
			10	------	9	205	------	243				34	------	11
			0	------	0	------	------	------				7	------	7
Dec. 5, 1944	12:35 p. m.	------	7	------	4	------	------	------	------	7.2	40	8	------	9
			14	------	7	------	------	------				7	------	6
			0	------	0	38	------	43				13	------	14
Jan. 3, 1945	12:45 p. m.	------	9	------	5	47	------	58	60	7.3	46	14	------	13
			17	------	9	47	------	57				14	------	14
			0	------	0	40	------	39				12	------	11
Jan. 17, 1945	12:40 p. m.	------	10	------	6	50	------	54	70	7.6	64	12	------	10
			20	------	11	46	------	50				12	------	11
			0	------	0	98	------	76				16	------	14
Jan. 30, 1945	1:55 p. m.	------	9	------	5	85	------	80	120	7.4	50	13	------	14
			18	------	9	95	------	78				14	------	16
			0	------	0	85	------	85				15	------	13
Feb. 13, 1945	12:40 p. m.	53	6	------	11	85	------	95	90	7.3	52	14	------	13
			12	------	22	88	------	80				14	------	14
			0	------	0	62	------	67				10	------	9
Mar. 6, 1945	12:10 p. m.	62	14	------	9	63	------	71	135	7.3	44	10	------	9
			27	------	18	65	------	80				9	------	9
			0	------	0	80	------	105				11	------	9
Mar. 20, 1945	11:55 a. m.	66	14	------	9	85	------	115	110	7.4	52	10	------	10
			27	------	17	95	------	120				11	------	9
			0	------	0	66	------	64				9	------	8
Apr. 10, 1945	do.	------	13	------	8	64	------	69	95	7.4	40	8	------	8
			25	------	15	70	------	75				9	------	8
			0	------	0	92	------	100				7	------	7
Apr. 24, 1945	11:25 a. m.	71	10	------	6	110	------	107	90	7.1	46	8	------	8
			19	------	10	110	------	107				7	------	7
			0	------	0	80	------	84				7	------	7
May 9, 1945	9:45 a. m.	------	13	------	12	80	------	85	120	7.1	42	7	------	6
			25	------	24	78	------	89				6	------	6
			0	------	0	87	------	89				7	------	6
May 23, 1945	9:55 a. m.	69	12	------	7	84	------	84	100	7.3	34	6	------	6
			23	------	13	87	------	91				6	------	6

June 6, 1945	9:50 a. m.	80	0		0	73		70	80	7.5	34	8		9
			10		4	70		72				8		8
			19		7	75		75				8		8
June 20, 1945	9:45 a. m.	83	0		0	57		46	80	7.0	36	10		8
			10		5	57		54				9		8
			18		8	00		62				10		8
July 3, 1945	9:25 a. m.	87	0		0	31		42	30	7.3	40	9		8
			13		3	53		46				9		9
			20		0	53		51				8		9
July 25, 1945	9:45 a. m.	85	0		0	70		90	90	7.4	46	8		8
			8		4	90		92				8		8
			16		7	95		94				8		8
Aug. 8, 1945	9:40 a. m.	88	0		0	49		48	75	7.3	28	8		8
			10		4	58		55				8		8
			19		7	56		62				8		8
Aug. 22, 1945	9:35 a. m.		0		0	(1)		(1)	30	7.3	42	8		9
			10		5	(1)		(1)				9		9
			19		8	(1)		(1)				9		9
Sept. 5, 1945	9:20 a. m.	83	0		0	25		25	35	7.5	30	12		11
			8		4	26		25				11		11
			15		7	28		28				11		11
Sept. 19, 1945	9:15 a. m.	83	0		0	(1)		(1)	45	7.2	20	9		10
			10		4	(1)		(1)				10		11
			19		7	(1)		(1)				10		10
Oct. 10, 1945	9:10 a. m.	74	0		0	33		30	45	7.2	32	8		8
			9		4	34		28				8		8
			17		7	35		35				7		7
Oct. 24, 1945	9:25 a. m.	68	0		0	28		29	40	7.3	28	10		11
			9		4	29		30				11		10
			17		7	31		32				11		10
Nov. 7, 1945	9:20 a. m.	60	0		0	28		28	35	7.3	44	10		9
			9		4	34		32				12		12
			18		0	31		30				10		10
Nov. 21, 1945	8:35 a. m.		0		0	28		26	40	7.3	38	10		9
			10		5	32		28				10		10
			19		18	34		30				10		9
Dec. 5, 1945	9:35 a. m.	53	0		0	34		37	50	7.2	44	10		9
			8		4	37		40				10		9
			15		6	40		39				10		10
Dec. 19, 1945	9:30 a. m.	47	0		0	90		02	80	7.2	42	8		9
			11		5	95		100				8		8
			20		0	95		90				10		9

[1] Less than 25.

D-00011212.0036

TABLE 13.—*Results of laboratory tests—Chickasaw Bogue River 3.7 miles above mouth*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet)			Analyses of samples								
						Turbidity			Composite samples			Chloride in parts per million		
			Right	Center	Left	Right	Center	Left	Color	pH	Total hardness	Right bank	Center	Left bank
Mar. 7, 1945	11:25 a. m.	...	...	0	...	...	(1)	...	45	6.2	14	...	20	...
			...	16	...	...	(1)	...				...	26	...
			...	30	...	...	(1)	...				...	20	...
Mar. 21, 1945	10:40 a. m.	...	...	0	...	...	(1)	...	45	7.0	12	...	10	...
			...	18	...	...	(1)	...				...	20	...
			...	35	...	...	(1)	...				...	22	...
Apr. 11, 1945	1:15 p. m.	...	...	0	...	...	(1)	...	40	6.2	12	...	14	...
			...	15	...	...	(1)	...				...	14	...
			...	29	...	...	(1)	...				...	14	...
Apr. 25, 1945	10:40 a. m.	...	...	0	...	...	(1)	...	70	6.0	12	...	11	...
			...	20	...	...	(1)	...				...	10	...
			...	39	...	...	(1)	...				...	10	...
May 10, 1945	2:05 p. m.	...	...	0	...	...	(1)	...	40	6.4	8	...	15	...
			...	18	...	...	(1)	...				...	15	...
			...	36	...	...	(1)	...				...	15	...
May 24, 1945	10:30 a. m.	...	...	0	...	...	(1)	...	40	6.2	10	...	13	...
			...	18	...	...	(1)	...				...	13	...
			...	36	...	...	(1)	...				...	13	...
June 7, 1945	10:45 a. m.	...	...	0	...	...	(1)	...	40	6.3	12	...	30	...
			...	16	...	...	(1)	...				...	23	...
			...	31	...	...	(1)	...				...	23	...
June 20, 1945	7:10 p. m.	...	...	0	...	...	(1)	...	60	6.2	14	...	39	...
			...	19	...	...	(1)	...				...	18	...
			...	37	...	...	(1)	...				...	21	...
July 3, 1945	7:15 p. m.	...	...	0	...	...	(1)	...	60	7.1	196	...	57	...
			...	17	...	...	(1)	...				...	291	...
			...	35	...	...	(1)	...				...	3,014	...
July 25, 1945	9:40 a. m.	...	...	0	...	...	25	...	100	6.6	10	...	18	...
			...	17	...	...	25	...				...	18	...
			...	32	...	...	26	...				...	18	...
Aug. 9, 1945	12:30 p. m.	...	...	0	...	...	(1)	...	70	7.5	26	...	51	...
			...	17	...	...	(1)	...				...	34	...
			...	33	...	...	(1)	...				...	27	...
Aug. 22, 1945	6:50 p. m.	...	...	0	...	...	(1)	...	40	7.3	272	...	525	...
			...	20	...	...	(1)	...				...	7,906	...
			...	38	...	...	(1)	...				...	8,437	...
Sept. 5, 1945	7:35 p. m.	...	...	0	...	...	(1)	...	30	7.2	268	...	603	...
			...	19	...	...	(1)	...				...	8,759	...
			...	37	...	...	(1)	...				...	9,440	...

D-00011212.0037

				0			(1)						408	
Sept. 19, 1945	0:45 p. m.			18			(1)		20	7.5	208		9,204	
				35			(1)						9,086	
				0			(1)						425	
Oct. 10, 1945	9 a. m.			18			(1)		30	7.5	224		9,860	
				35			(1)						9,975	
				0			(1)						957	
Oct. 24, 1945	0:15 a. m.			20			(1)		20	7.5	202		9,798	
				38			(1)						10,207	
				0			(1)						532	
Nov. 7, 1945	9:05 a. m.			19			(1)		30	7.5	220		9,844	
				36			(1)						10,266	
				0			(1)						11,418	
Nov. 21, 1945	8:45 a. m.			19			(1)		20	7.1	216		9,794	
				36			(1)						10,384	
				0			(1)						674	
Dec. 5, 1945	9:15 a. m.			18			(1)		20	7.3	200		10,266	
				35			(1)						10,384	
				0			(1)						957	
Dec. 19, 1945	9:10 a. m.			19			(1)		50	6.8	144		9,794	
				36			(1)						10,207	
				0			(1)						13	
Jan. 9, 1946	10:15 a. m.			20			(1)		75	6.0	10		13	
				38			(1)						13	

[1] Less than 25

D-00011212.0038

TABLE 14.—*Results of laboratory tests—Three Mile Creek 1 mile above mouth*

Date of collection	Time of collection	Water temperature, degrees (F.)	Depth of sample (feet): Right	Depth of sample (feet): Center	Depth of sample (feet): Left	Turbidity: Right	Turbidity: Center	Turbidity: Left	Composite samples: Color	Composite samples: pH	Composite samples: Total hardness	Chloride in parts per million: Right bank	Chloride in parts per million: Center	Chloride in parts per million: Left bank
			-----	0	-----	-----	38	-----				-----	118	-----
Mar. 7, 1945	11 a. m.	-----	-----	6	-----	-----	30	-----	65	6.7	42	-----	118	-----
			-----	10	-----	-----	49	-----				-----	118	-----
			-----	0	-----	-----	57	-----				-----	40	-----
Mar. 21, 1945	10:20 a. m.	-----	-----	3.5	-----	-----	50	-----	90	7.2	26	-----	43	-----
			-----	6	-----	-----	50	-----				-----	51	-----
			-----	0	-----	-----	47	-----				-----	90	-----
Apr. 11, 1945	1:40 p. m.	-----	-----	5	-----	-----	42	-----	70	7.0	50	-----	106	-----
			-----	9	-----	-----	42	-----				-----	92	-----
			-----	0	-----	-----	24	-----				-----	20	-----
Apr. 25, 1945	11:10 a. m.	-----	-----	5	-----	-----	25	-----	70	6.2	32	-----	30	-----
			-----	9	-----	-----	27	-----				-----	31	-----
			-----	0	-----	-----	40	-----				-----	115	-----
May 10, 1945	10:30 a. m.	-----	-----	5	-----	-----	40	-----	60	7.1	60	-----	115	-----
			-----	9	-----	-----	40	-----				-----	155	-----
			-----	0	-----	-----	30	-----				-----	200	-----
May 24, 1945	12:15 p. m.	-----	-----	5	-----	-----	30	-----	50	7.1	138	-----	320	-----
			-----	0	-----	-----	33	-----				-----	320	-----
			-----	0	-----	-----	28	-----				-----	408	-----
June 7, 1945	11:20 a. m.	-----	-----	5	-----	-----	27	-----	40	7.3	156	-----	303	-----
			-----	9	-----	-----	30	-----				-----	514	-----
			-----	0	-----	-----	70	-----				-----	94	-----
June 20, 1945	7:40 p. m.	-----	-----	4	-----	-----	73	-----	100	6.8	52	-----	90	-----
			-----	7	-----	-----	87	-----				-----	78	-----
			-----	0	-----	-----	24	-----				-----	333	-----
July 3, 1945	7:40 p. m.	-----	-----	5	-----	-----	24	-----	100	7.4	150	-----	326	-----
			-----	9	-----	-----	38	-----				-----	425	-----
			-----	0	-----	-----	54	-----				-----	51	-----
July 26, 1945	9:15 a. m.	-----	-----	5	-----	-----	65	-----	80	6.7	36	-----	53	-----
			-----	0	-----	-----	67	-----				-----	55	-----
			-----	0	-----	-----	(1)	-----				-----	956	-----
Aug. 9, 1945	12:55 p. m.	-----	-----	0	-----	-----	(1)	-----	50	7.0	182	-----	1,284	-----
			-----	11	-----	-----	(1)	-----				-----	2,637	-----
			-----	0	-----	-----	(1)	-----				-----	2,005	-----
Aug. 22, 1945	7:15 p. m.	-----	-----	5	-----	-----	(1)	-----	40	7.0	280	-----	2,183	-----
			-----	0	-----	-----	(1)	-----				-----	2,242	-----
			-----	0	-----	-----	(1)	-----				-----	2,000	-----
Sept. 5, 1945	8:10 p. m.	-----	-----	0	-----	-----	(1)	-----	30	6.9	310	-----	2,340	-----
			-----	11	-----	-----	(1)	-----				-----	6,915	-----

Sept. 10, 1945	7:10 p. m.			0			(1)		30	7.4	244		1,820	
				8			(1)						2,065	
				15			(1)						7,493	
Oct. 10, 1945	9:30 a. m.			0			(1)		40	7.2	192		744	
				6			(1)						1,700	
				11			(1)						8,710	
Oct. 24, 1945	9:45 a. m.			0			(1)		20	7.5	184		2,553	
				6			(1)						3,001	
				11			(1)						5,909	
Nov. 7, 1945	9:30 a. m.			0			(1)		20	7.1	145		1,084	
				8			(1)						3,363	
				14			(1)						5,900	
Nov. 21, 1945	9 a. m.			0			(1)		20	7.3	236		3,260	
				7			(1)						3,658	
				13			(1)						7,375	
Dec. 5, 1945	9:45 a. m.			0			(1)		20	6.9	160		1,083	
				7			(1)						1,888	
				12			25						6,130	
Dec. 19, 1945	9:40 a. m.			0			72		140	7.1	34		2,553	
				7			80						3,001	
				13			84						5,900	
Jan. 9, 1946	10:45 a. m.			0			33		130	6.6	28		52	
				8			30						53	
				14			31						54	

[1] Less than 25.

D-00011212.0040

DISCUSSION AND CONCLUSIONS

33. The salinity survey was made to determine as nearly as possible the salinity line in the Mobile River and its tributaries. The tributaries included in this report are Three Mile Creek, Chickasaw Creek, and the head of Tensaw River. A total of 2,320 water samples were collected and analyzed. In general, samples were obtained every other week, commencing November 9, 1944, and ending January 9, 1946. These samples were collected from 14 different ranges. Analyses were made by methods in general use; however, it is realized that in some cases more accurate methods could have been employed. For the scope of this study it is believed that the additional time and equipment necessary to secure greater accuracies would not have been justified.

34. The test results indicate that the salt concentration in that portion of the Mobile River investigated was affected only slightly by daily variations in tide. This is probably due to the small daily variation in tide and the location of Mobile River which is in the marginal zone of salt concentration. The mean tidal variation at Mobile is about 1.25 feet. Tide charts for the period November 1944 through January 1946 for the Mobile gage are presented on plates 17 through 33.[1] Also shown on plates 17 to 23[2] are tide charts for the Mount Vernon landing gage at mile 41. This gage was established November 19, 1945, and was removed January 9, 1946, because of flood conditions. A study of plates 17 to 23[2] shows the similarity in the tidal variation at low stages between the Mobile and Mount Vernon gages.

35. Further investigations revealed that abnormal tidal conditions produced little effect on the movement of salt in the Mobile River. For example, high tide at Mobile on April 1, 1945, as a result of a tropical disturbance was 4.4 mean sea level, or 3.5 feet above normal high tide. This disturbance occurred during a period of minimum salt intrusion and the effect of the abnormal high tide on salt intrusion in the Mobile River was investigated. Samples obtained immediately afterward at the three lowermost ranges indicated that this tidal condition did not affect the salt intrusion in the Mobile River.

36. Since it was found that tides had little or no influence on the movement of salt upstream in the Mobile River above Government Street, the extent of salt intrusion was correlated with the discharge of the river. For this purpose the daily discharge at the head of the Mobile River was estimated from the daily discharges of the Tombigbee River at Leroy and the Alabama River at Claiborne, and used as an index in the salinity studies.

37. The relation between the chloride concentration and daily discharge is shown on plate 8. This chart shows that salt water penetrates farthest upstream during the lowest river flows, and that above certain river discharges the salt water is completely displaced and the water in the Mobile River becomes fresh as far downstream as Government Street. In samples collected on November 9, 1944, the presence of 2,650 parts per million of chloride in the bottom sample of range 4 (mile 20.5) as compared with 32 parts per million found on the surface and at middepth, indicates that under the low-flow conditions at that time salinity invasion did not extend far above range 4.

[1] Only plates 17 and 24 printed.
[2] Only plate 17 printed.

This represents the extreme condition found during the period covered by this study—being the maximum concentration of chloride at the farthest point upstream. Salt-water intrusion reaches that point (mile 20.5) only when the discharge of the Mobile River has decreased to 10,000 cubic feet per second, which is about the minimum daily discharge for an average dry period. It is apparent that under extreme low-flow conditions salt water would penetrate some distance upstream from that point.

38. A further study of plate 8 shows that, as the discharge approaches or exceeds 15,000 cubic feet per second, there is a total displacement of salt water at ranges 3 and 4, and a sharp decrease in the chloride concentration at ranges 1 and 2. When the discharge reaches or exceeds 50,000 cubic feet per second at the head of Mobile River, the maximum chloride concentration at range 1 decreases to about 12 parts per million, the normal chloride content of fresh-water streams in this area. Several check samples collected under that condition in the Mobile River at Government Street, 3 miles below range 1, showed only small chloride concentration. It can then be concluded that fresh water displaces salt water in the entire reach of the Mobile River for discharges of over 50,000 cubic feet per second. While no tests were made below the mouth of the Mobile River, the muddy condition of Mobile Bay suggests that during high-water periods fresh water may extend some distance out into Mobile Bay. Plate 24 indicates the salt intrusion in the Mobile River under various conditions of river flow.

39. The general conclusions derived from a study of the tables, charts, and results of tests presented with this report are as follows:

(a) Under conditions encountered in this study, tidal variation has little if any effect on salt intrusion in the Mobile River.

(b) The farthest point upstream reached by salt-water intrusion is slightly above range 4 or mile 21, and this lasts only a short time. During extreme low-water conditions in the Mobile River it can be expected that this upstream limit would be exceeded.

(c) The chloride concentration is dependent on the river discharge, and displacement of salt water in the upper reaches of the river is noticeable when the discharge exceeds 10,000 cubic feet per second. When discharge exceeds 50,000 cubic feet per second, water can be considered fresh from the head to the mouth of the river. The salinity line is not confined to any one location, but moves up and down stream depending on the river discharge. An inspection of plates 10 to 14 [1] reveals that, during the normally low-water period June 1 to November 30, a heavy concentration of chloride occurs in the river below range 2, mile 7, and for a shorter period—August 15 to November 15—below range 3-A, mile 15.4. During the minimum low-water period—September 15 to October 31—the salt intrusion moves upstream to about range 4, mile 20.5. If the period studied in this report depicts average conditions, it can be concluded that for the period June 1 to January 15 salt intrusion takes place in the Mobile River. The ingress and egress of the salt water is gradual, depending on the discharge of the river, and reaches the maximum concentration and extent during the low-water period. September through November. From January 15 to June 1 flood stages usually prevail, and the displacement of salinity is so complete that the entire river can be considered fresh. The isochlor pattern for the Mobile River under extreme high- and low-water conditions during the period November 1944 through January 1946 is shown on plate 7.

[1] Not printed.

RECOMMENDATIONS

40. It is recommended that this report and accompanying papers be printed and made available to local interests.

MARK M. BOATNER, Jr.,
Colonel, Corps of Engineers,
District Engineer.

[First endorsement]

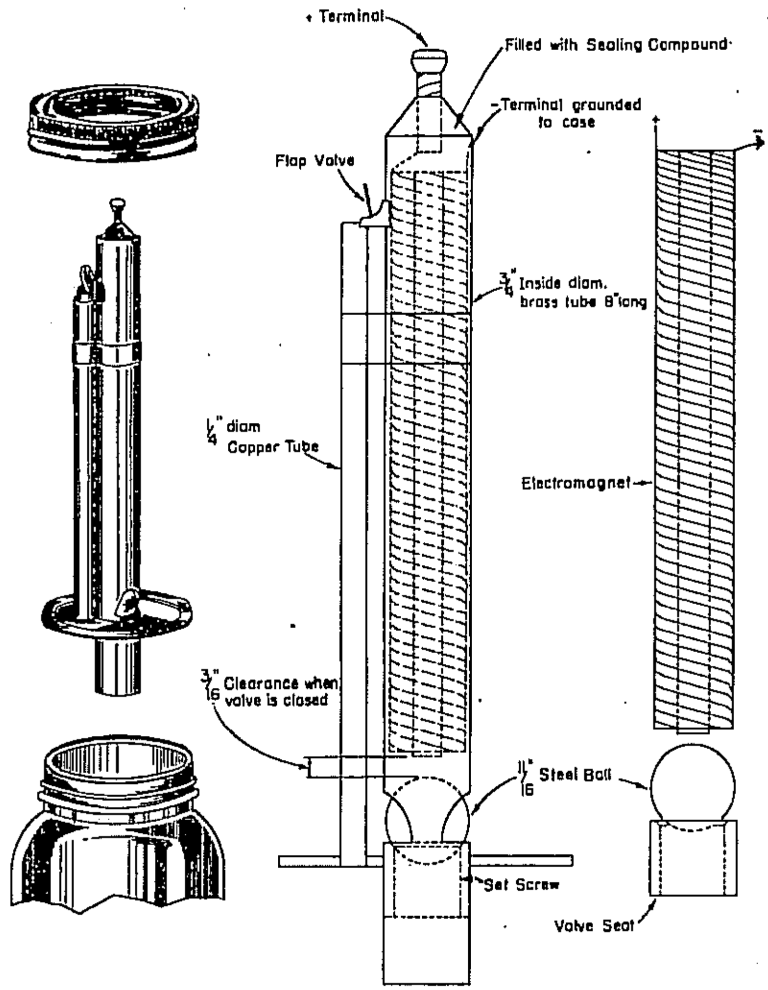
OFFICE, DIVISION ENGINEER,
SOUTH ATLANTIC DIVISION,
Atlanta, Ga., June 28, 1946.

To: The Chief of Engineers, United States Army.

The division engineer concurs in the conclusions and recommendation of the district engineer.

JAMES B. NEWMAN, Jr.,
Brigadier General, United States Army,
Division Engineer.

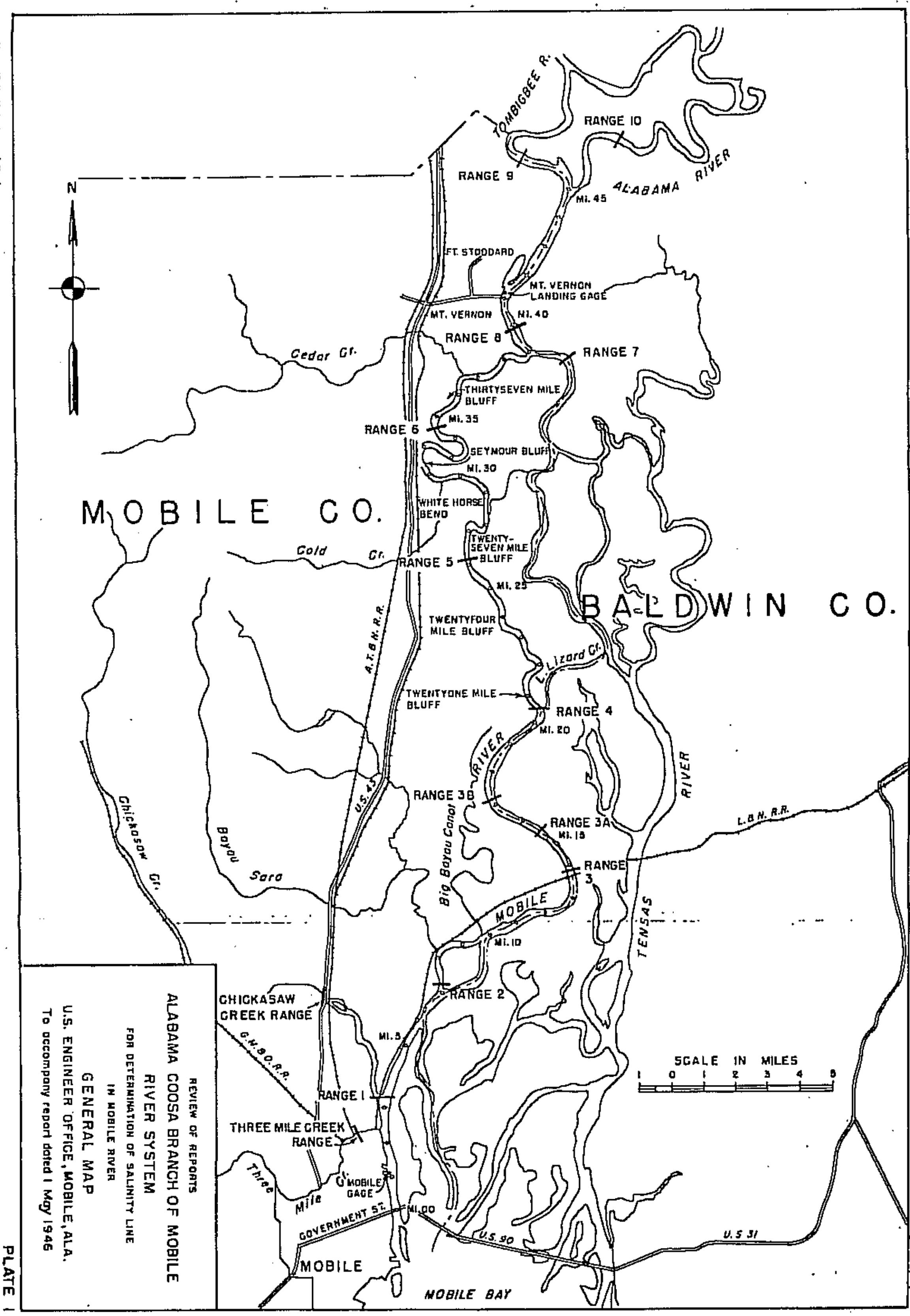
O



ELECTROMAGNETIC POINT-WATER SAMPLER

PLATE 6

83359 O - 49 (Inside back cover) No. 3

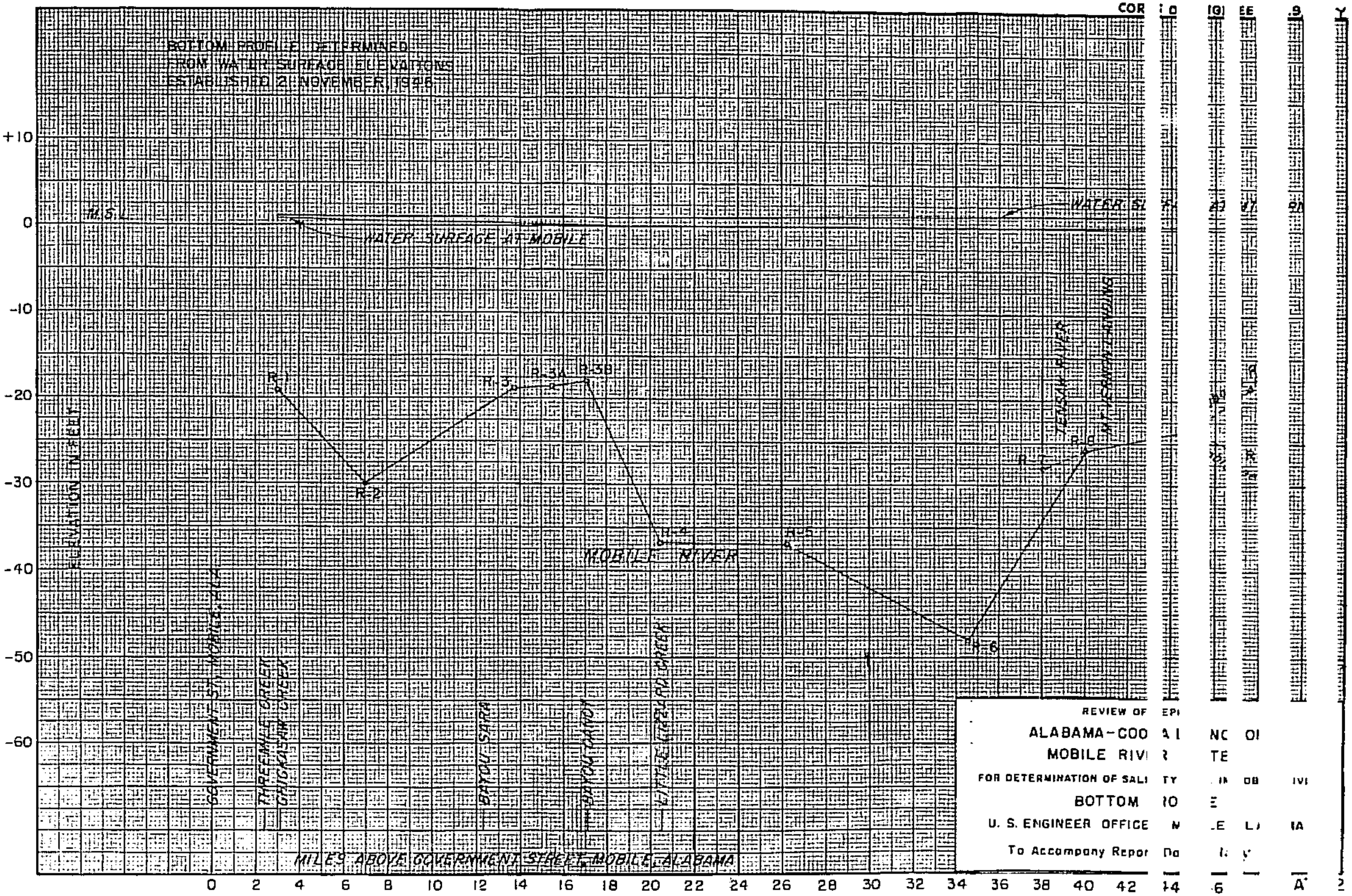


REVIEW OF REPORTS
ALABAMA COOSA BRANCH OF MOBILE RIVER SYSTEM
FOR DETERMINATION OF SALINITY LINE IN MOBILE RIVER
GENERAL MAP
U.S. ENGINEER OFFICE, MOBILE, ALA.
To accompany report dated 1 May 1946

PLATE 1

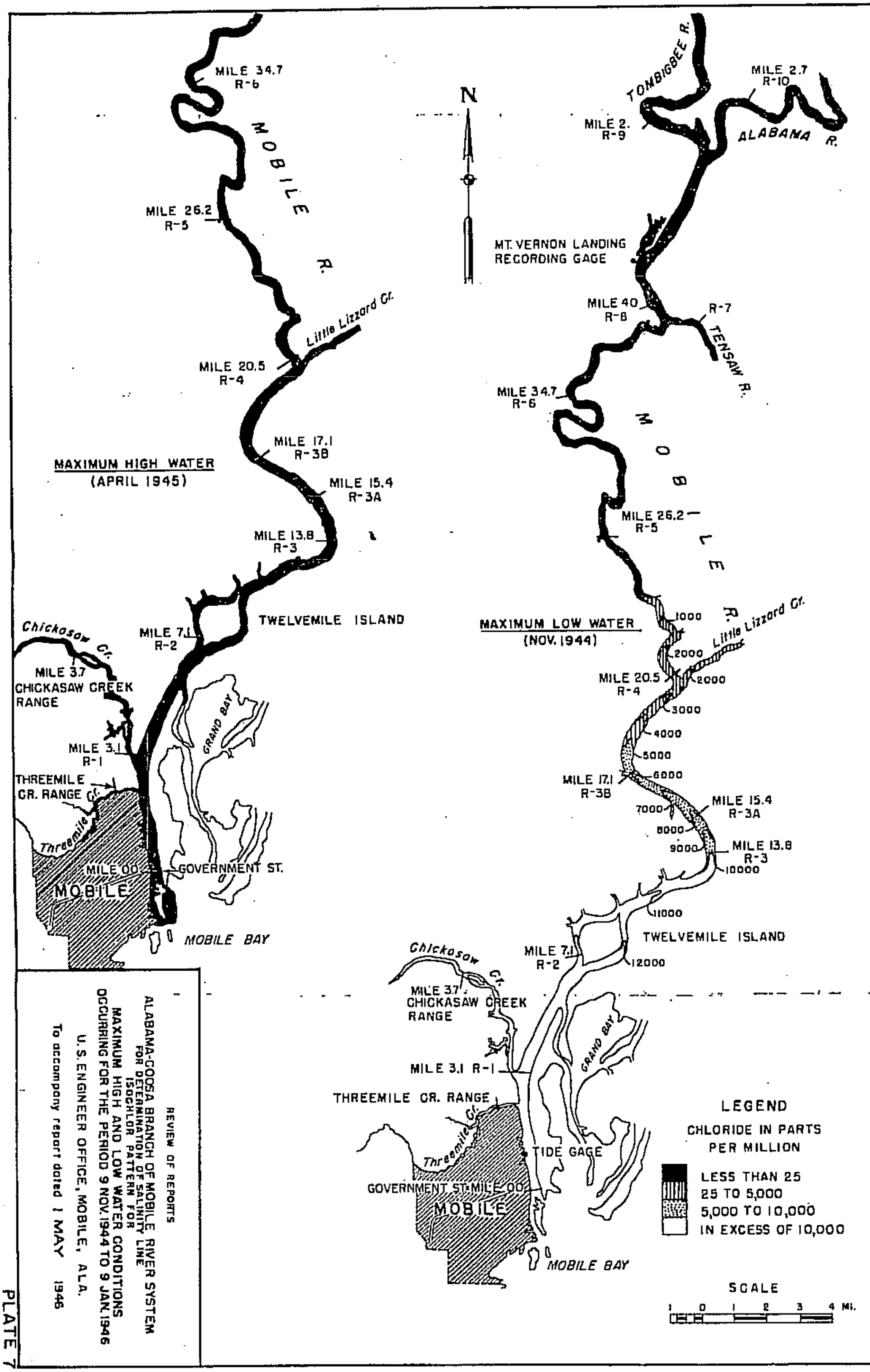
CORPS OF ENGINEERS, U.S. ARMY

83239 O - 48 (Inside back cover) No. 1



BOTTOM PROFILE DETERMINED
FROM WATER SURFACE ELEVATIONS
ESTABLISHED 2 NOVEMBER, 1946
ELEVATION IN FEET
+10
0
-10
-20
-30
-40
-50
-60
M.S.L.
WATER SURFACE AT MOBILE
WATER SL
R-1
R-2
R-3
R-3A
R-3B
R-4
R-5
R-6
R-7
R-8
MOBILE RIVER
TENSAW RIVER
MT. VERNON LANDING
GOVERNMENT ST., MOBILE, ALA.
THREEMILE CREEK
CHICKASAW CREEK
BAYOU SARA
BAYOU CANOT
LITTLE LIZARD CREEK
MILES ABOVE GOVERNMENT STREET, MOBILE, ALABAMA
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
COR
REVIEW OF
ALABAMA-COO
MOBILE RIV
FOR DETERMINATION OF SAL
BOTTOM
U. S. ENGINEER OFFICE
To Accompany Repor

83859

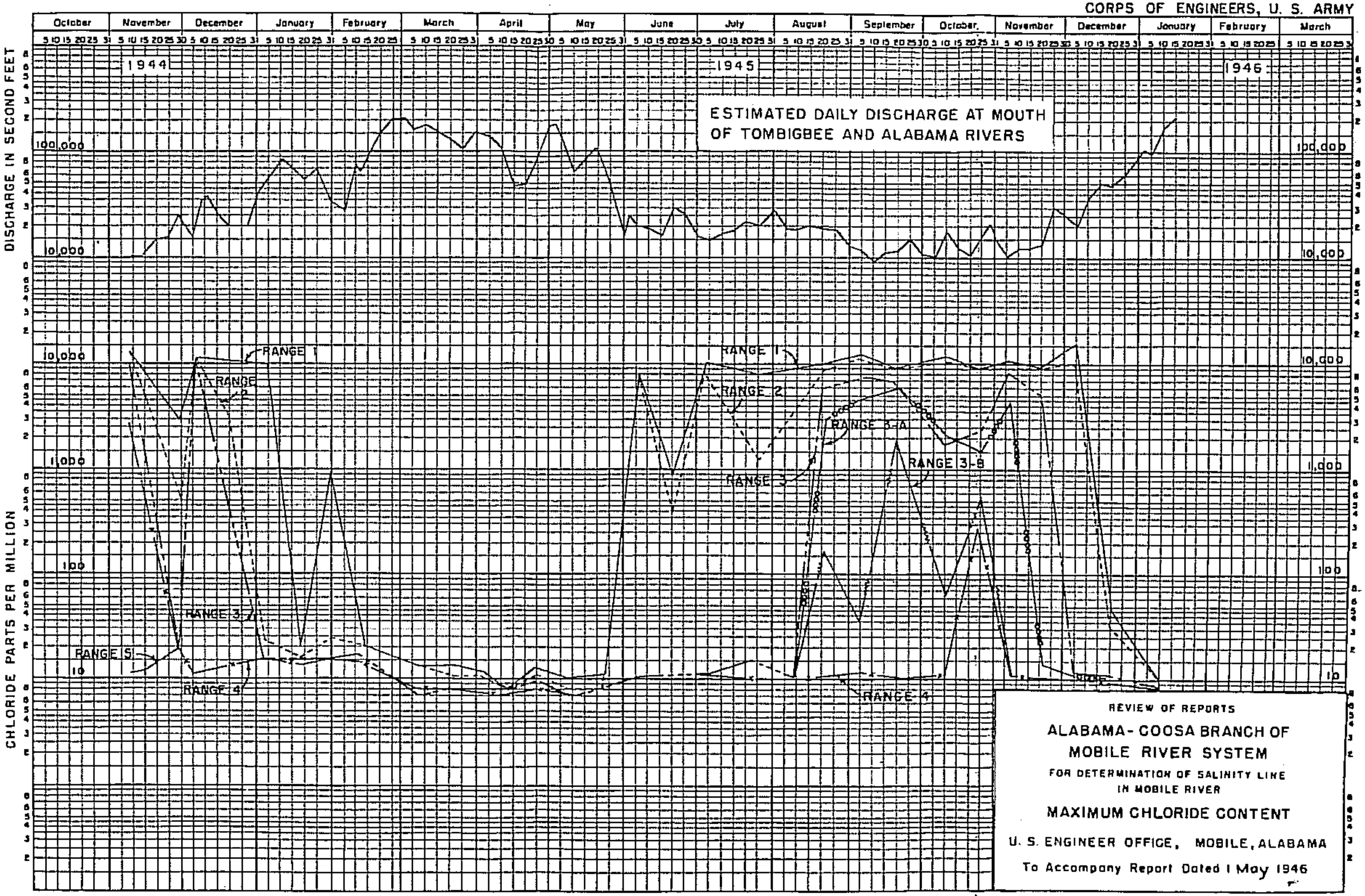


REVIEW OF REPORTS
ALABAMA-COOSA BRANCH OF MOBILE RIVER SYSTEM
FOR DETERMINATION OF SALINITY LINE
ISOCHLOR PATTERN FOR
MAXIMUM HIGH AND LOW WATER CONDITIONS
OCCURRING FOR THE PERIOD 9 NOV. 1944 TO 9 JAN. 1946
U.S. ENGINEER OFFICE, MOBILE, ALA.
To accompany report dated 1 MAY 1946

PLATE 7

CORPS OF ENGINEERS, U.S. ARMY

CORPS OF ENGINEERS, U. S. ARMY



REVIEW OF REPORTS

ALABAMA-COOSA BRANCH OF MOBILE RIVER SYSTEM

FOR DETERMINATION OF SALINITY LINE IN MOBILE RIVER

MAXIMUM CHLORIDE CONTENT

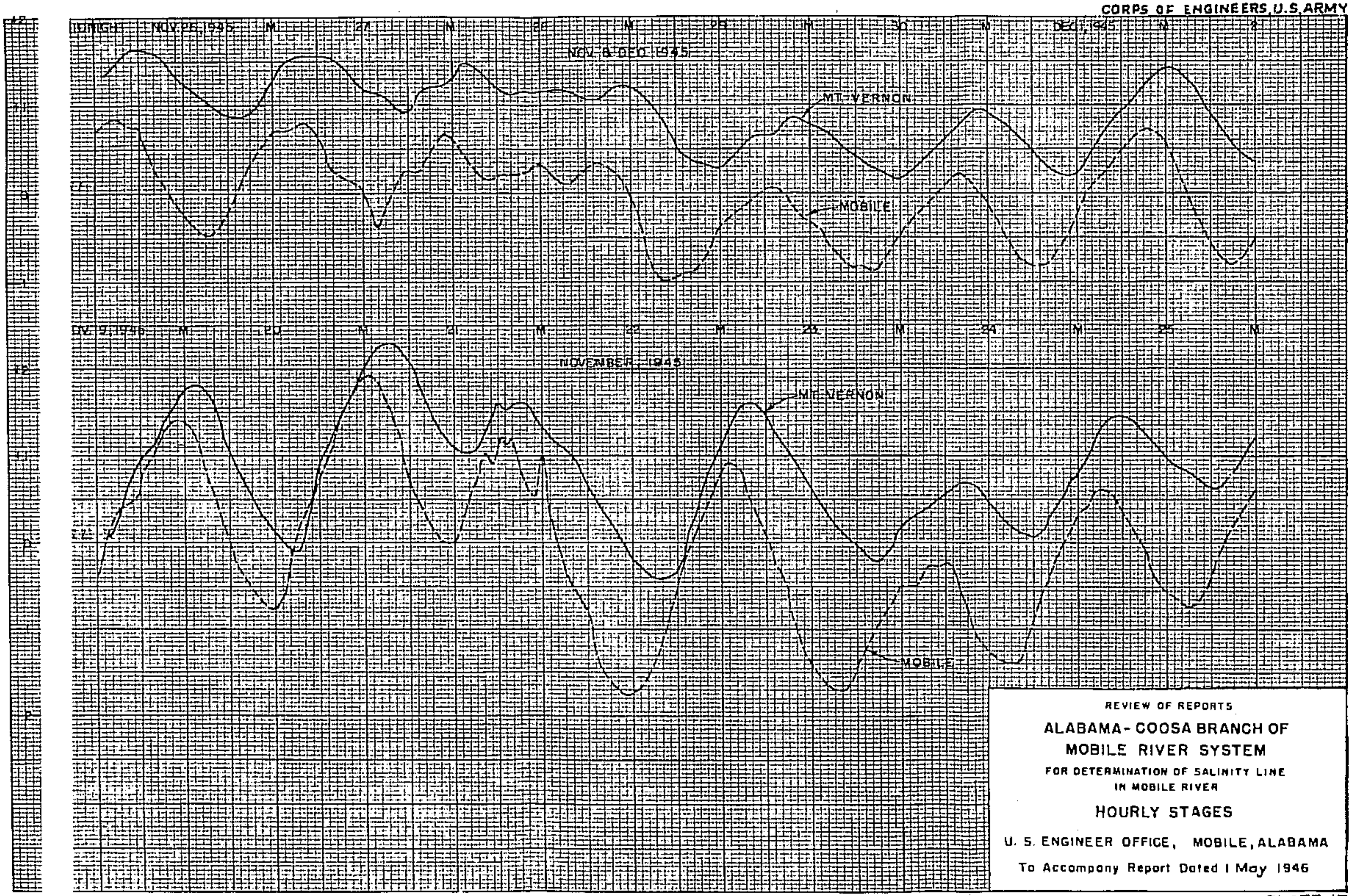
U. S. ENGINEER OFFICE, MOBILE, ALABAMA

To Accompany Report Dated 1 May 1946

83359 O - 48 (Inside back cover) No. 8

PLATE 8

D-00011212.0048



REVIEW OF REPORTS

ALABAMA - COOSA BRANCH OF MOBILE RIVER SYSTEM

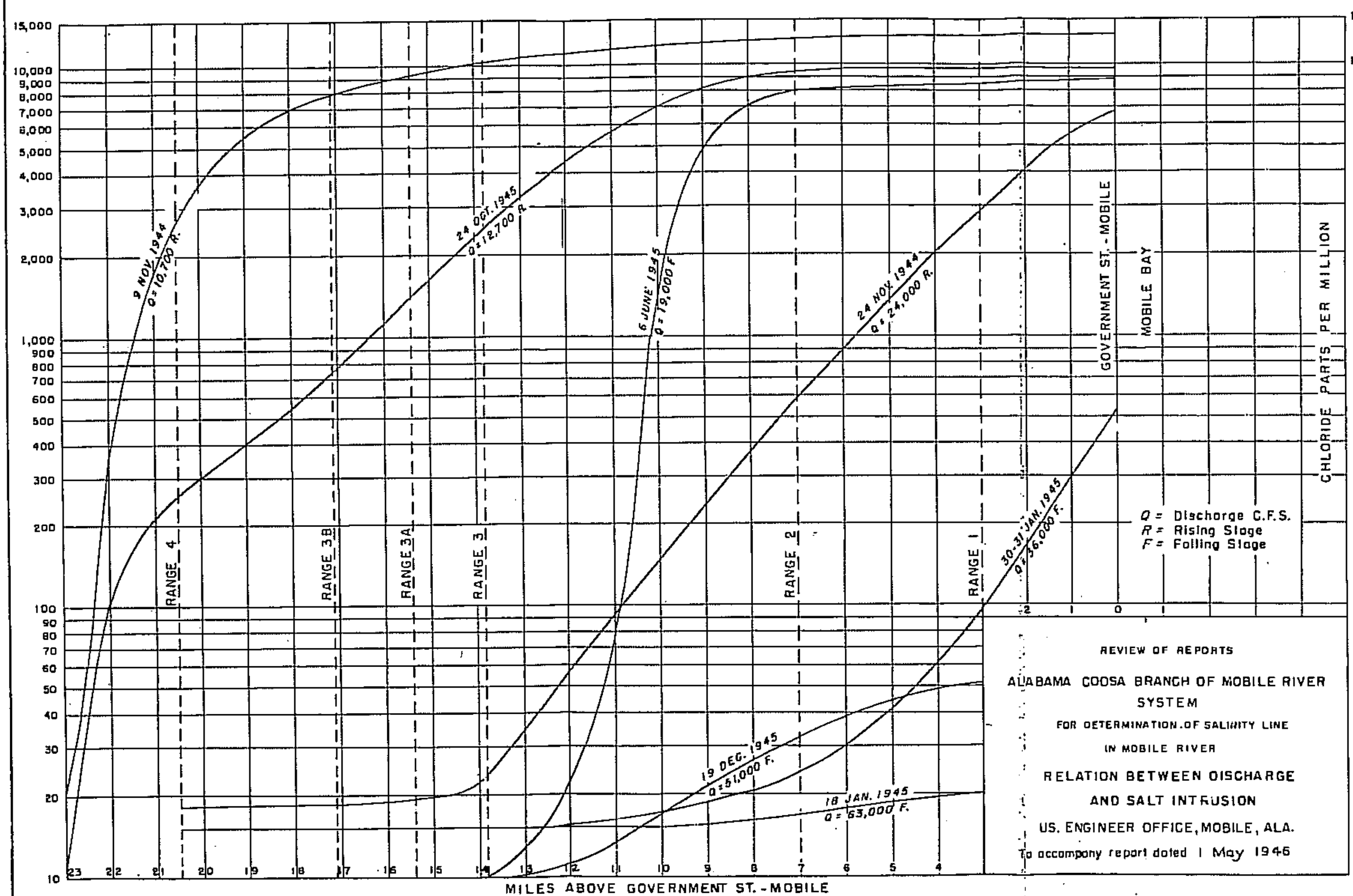
FOR DETERMINATION OF SALINITY LINE IN MOBILE RIVER

HOURLY STAGES

U. S. ENGINEER OFFICE, MOBILE, ALABAMA

To Accompany Report Dated 1 May 1946

PLATE 17



REVIEW OF REPORTS

ALABAMA COOSA BRANCH OF MOBILE RIVER SYSTEM

FOR DETERMINATION OF SALINITY LINE IN MOBILE RIVER

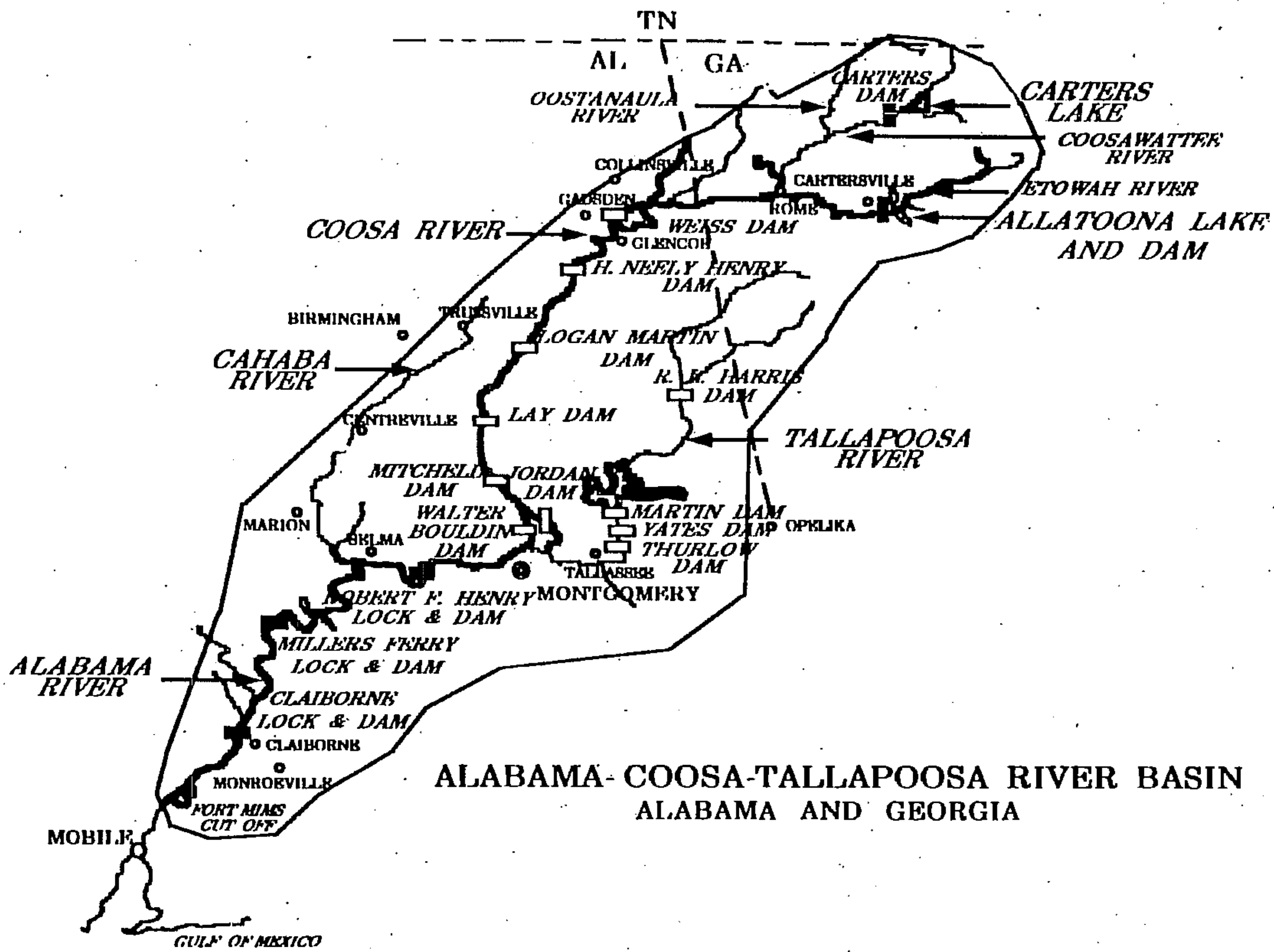
RELATION BETWEEN DISCHARGE AND SALT INTRUSION

US. ENGINEER OFFICE, MOBILE, ALA.

To accompany report dated 1 May 1946

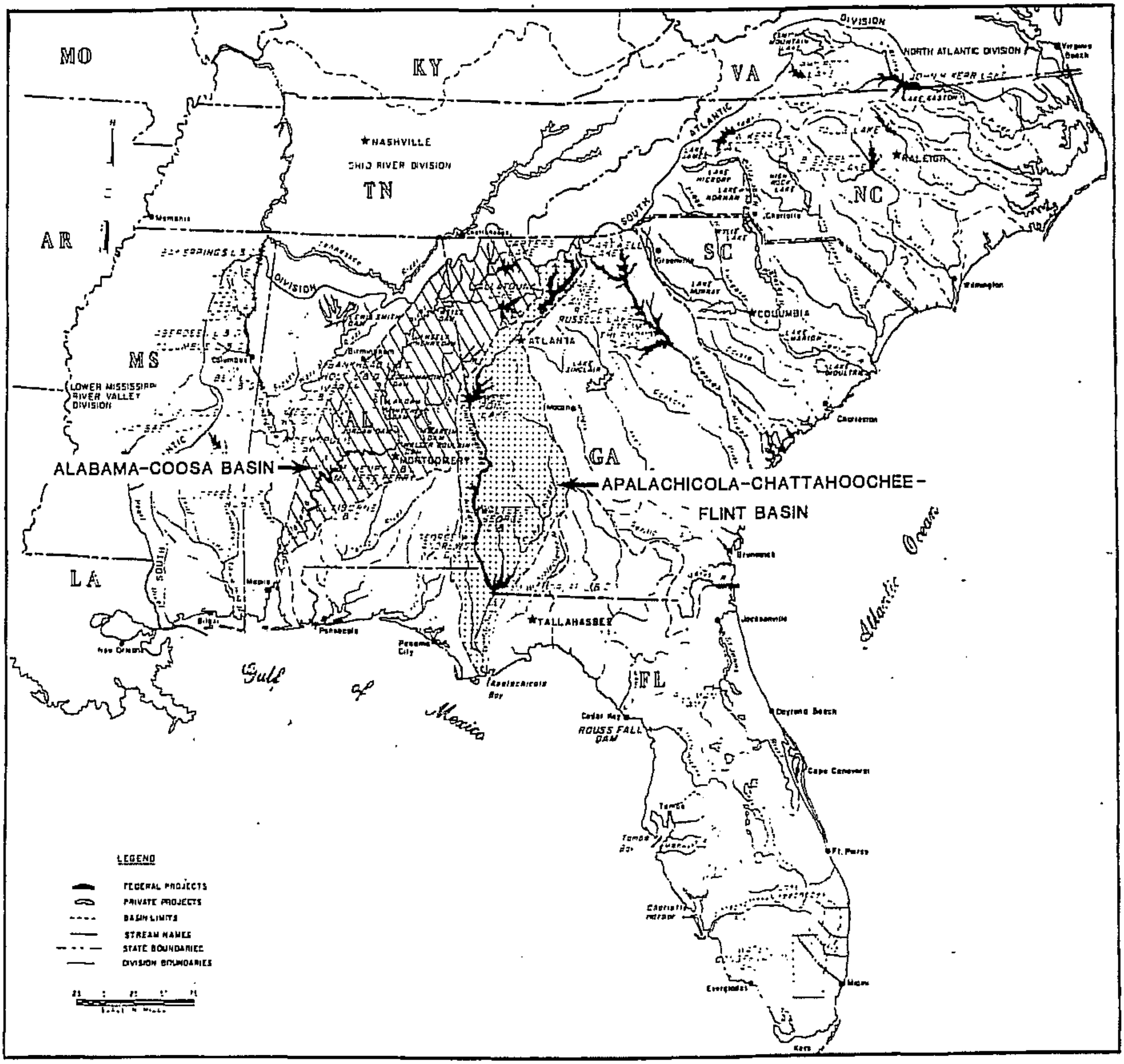
PLATE 24

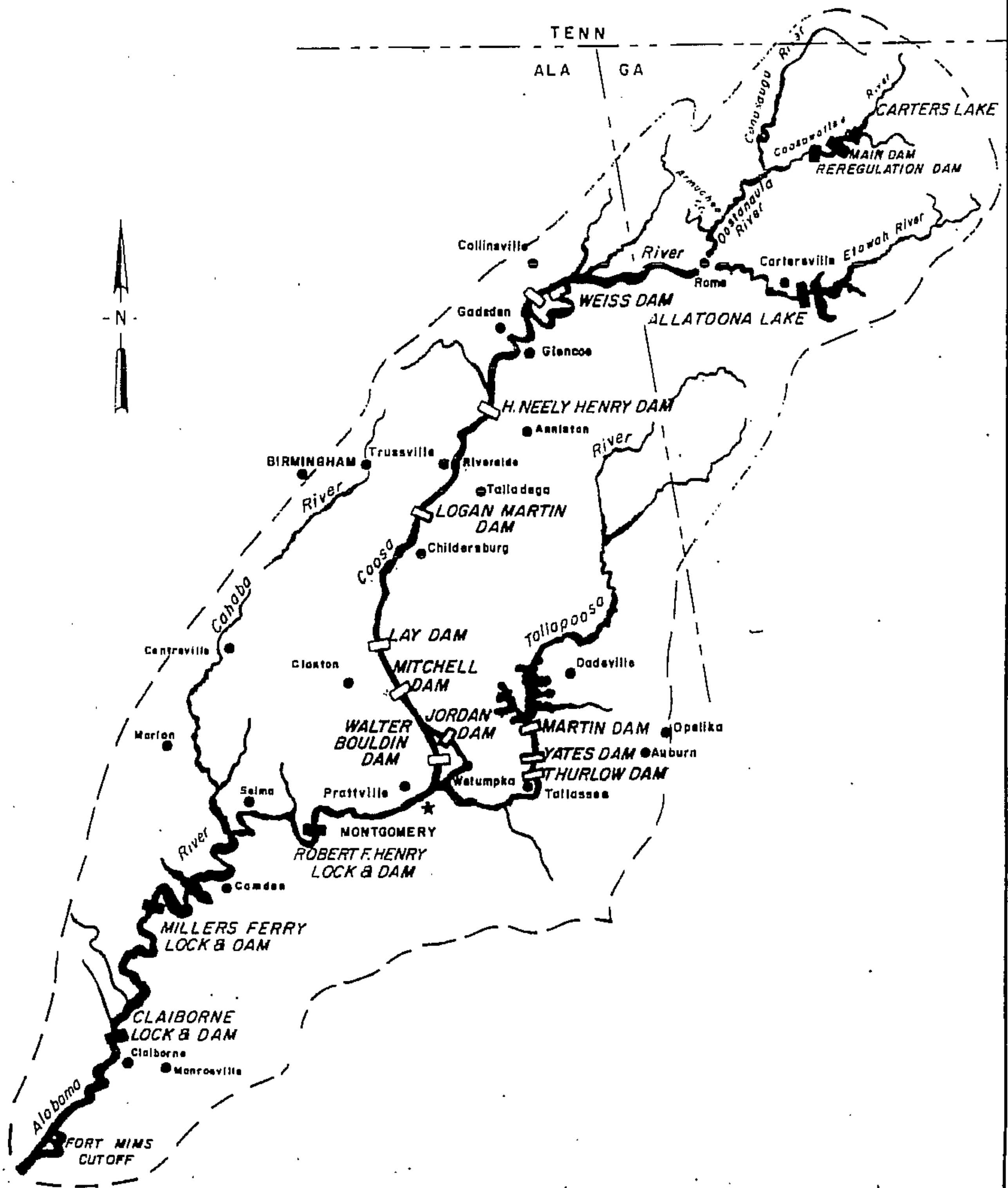
63359 O - 49 (Inside back cover) No. 7



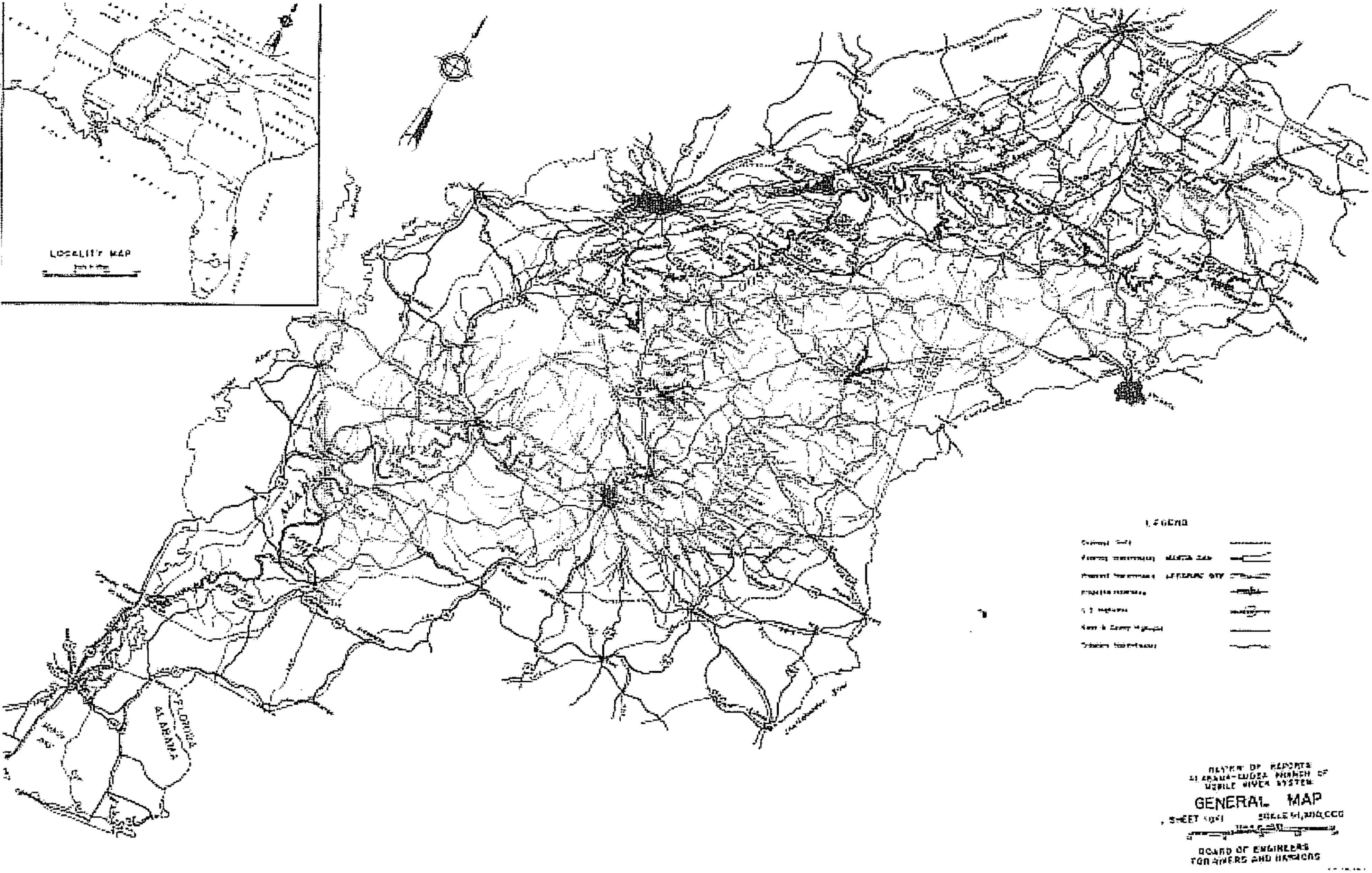
ALABAMA-COOSA-TALLAPOOSA RIVER BASIN
ALABAMA AND GEORGIA

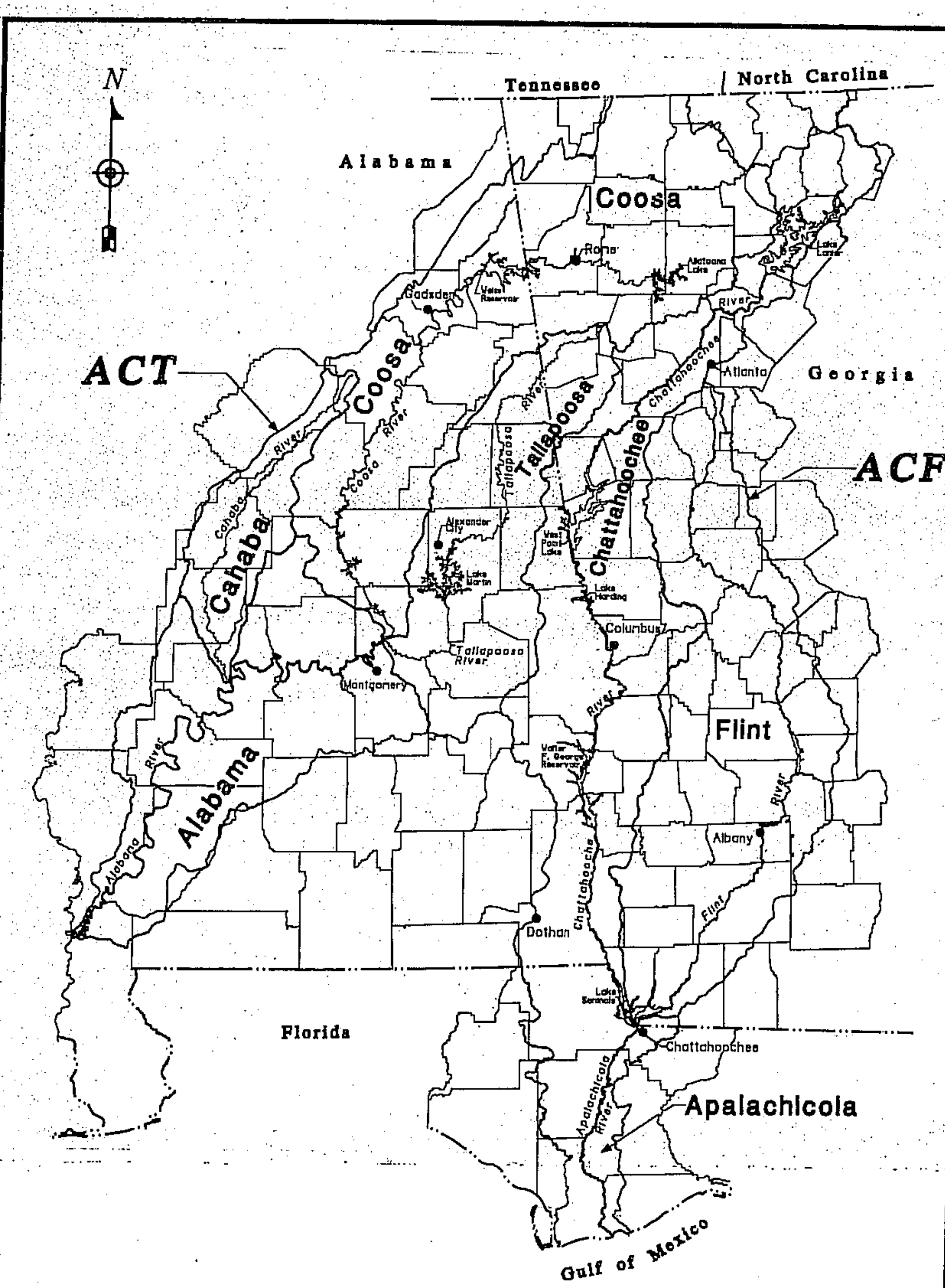
Figure 2


MO
KY
VA
NORTH ATLANTIC DIVISION
JOHN H KERR LAKE
NASHVILLE
OHIO RIVER DIVISION
TN
NC
RALEIGH
AR
SC
COLUMBIA
MS
LOWER MISSISSIPPI RIVER VALLEY DIVISION
ATLANTA
AL
GA
ALABAMA-COOSA BASIN
MONTGOMERY
APALACHICOLA-CHATTAHOOCHEE-FLINT BASIN
LA
TALLAHASSEE
Gulf of Mexico
Atlantic Ocean
FL
ROUSS FALL DAM
LEGEND
FEDERAL PROJECTS
PRIVATE PROJECTS
BASIN LIMITS
STREAM NAMES
STATE BOUNDARIES
DIVISION BOUNDARIES



Alabama-Coosa River Basin
(Alabama and Georgia)


LOCALITY MAP
LEGEND
FLORIDA
ALABAMA
GENERAL MAP
BOARD OF ENGINEERS
FOR RIVERS AND HARBORS



LEGEND

Major Basin Boundaries...

Sub-Basin Boundaries........

State Boundaries................

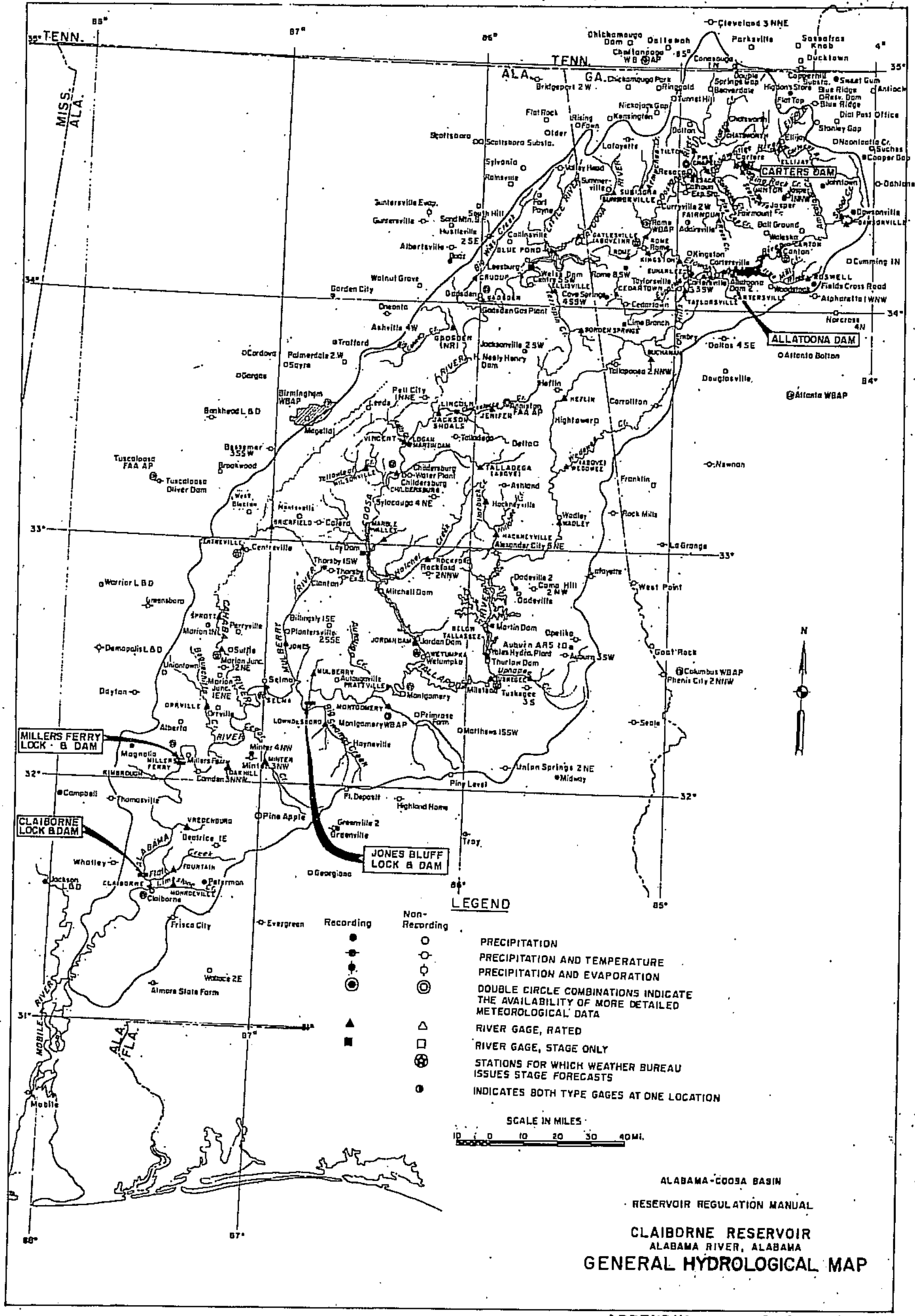
County Boundaries.............

Figure 1.

STUDY AREA

Apalachicola - Chattahoochee - Flint
and
Alabama - Coosa - Tallapoosa
Basins Comprehensive Study

Gulf Engineers & Consultants, Inc.


TENN.
ALA.
GA.
MISS.
FLA.
CARTERS DAM
ALLATOONA DAM
MILLERS FERRY
LOCK & DAM
CLAIBORNE
LOCK & DAM
JONES BLUFF
LOCK & DAM
Birmingham WBAP
Atlanta WBAP
Montgomery
Selma
Mobile
Claiborne
Rome
Gadsden
Tuscaloosa FAA AP
Columbus WBAP
LEGEND
Recording
Non-Recording
PRECIPITATION
PRECIPITATION AND TEMPERATURE
PRECIPITATION AND EVAPORATION
DOUBLE CIRCLE COMBINATIONS INDICATE THE AVAILABILITY OF MORE DETAILED METEOROLOGICAL DATA
RIVER GAGE, RATED
RIVER GAGE, STAGE ONLY
STATIONS FOR WHICH WEATHER BUREAU ISSUES STAGE FORECASTS
INDICATES BOTH TYPE GAGES AT ONE LOCATION
SCALE IN MILES
10 0 10 20 30 40 MI.
N
ALABAMA-COOSA BASIN
RESERVOIR REGULATION MANUAL
CLAIBORNE RESERVOIR
ALABAMA RIVER, ALABAMA
GENERAL HYDROLOGICAL MAP