Water Budget of Tombigbee River – Tenn-Tom Waterway from Headwaters to Junction with Black Warrior River

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PREFACE

This report was prepared with funding from the Northern Gulf Institute (NGI) -- Watershed Modeling Improvements to Enhance Coastal Ecosystems (NGI07-MSU-03).

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Dr. David Shaw is Director of the NGI, Mr. Glade Woods is Co-Director, and Dr. Michael Carron is Chief Scientific Officer. The NGI web site is at http://www.northerngulfinstitute.org/home/ngi.php.

ABSTRACT

The purpose of this project is to develop a water budget tool for rivers and demonstrate it for the Tombigbee River-Tenn-Tom Waterway. The Tenn-Tom Waterway was completed in 1984, linking the Tennessee River to Mobile Bay via the Tombigbee River. Water from the Tennessee River watershed flows through Whitten Lock near Bay Springs, Mississippi, and merges with flows from the Tombigbee Watershed. Although the primary authorized purpose for the Waterway is navigation, now it is being looked to for surface water supply for current and future water demands in Northeast Mississippi. Before watershed managers can make well-informed decisions about permitting withdrawals, the amount of water available must be quantified – a water budget. This was attempted through the compilation of data into a spreadsheet schematic of the Tombigbee River and Tenn-Tom Waterway. Data were acquired through various methods and sources including Geographical Information Systems, USGS stream flow Data, MDEQ, ADECA, and USACE personal communication, and the MDEQ EnSearch Engine. A meld of these data into the spreadsheet format transforms them into the volumetric discharges for different flow situations at locations along the river and waterway. Using the information to estimate mean flows at various locations is a reasonable use of the data; however, identifying the probability of minimum flows requires a more sophisticated approach.

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I. Introduction

Purpose

The purpose of this project is to develop a water budget tool for rivers and demonstrate it for the Tombigbee River-Tenn-Tom Waterway. This work is part of the Northern Gulf Institute project, *Watershed Modeling Improvements to Enhance Coastal Ecosystems,* which has as one objective, "Promote improved use of the most appropriate technology to support watershed decision support." A functional water budget is the first step in managing water resources, so the work presented here is intended to provide an appropriate tool for that purpose.

Background

The Tombigbee River and the connected Tenn-Tom Waterway, which drains parts of Tennessee, Mississippi, and Alabama, is part of the Mobile basin, as shown in Figures A and B. The Tombigbee basin contributes nearly half of the freshwater flows into Mobile Bay (McAnally and Ballweber. 2005).

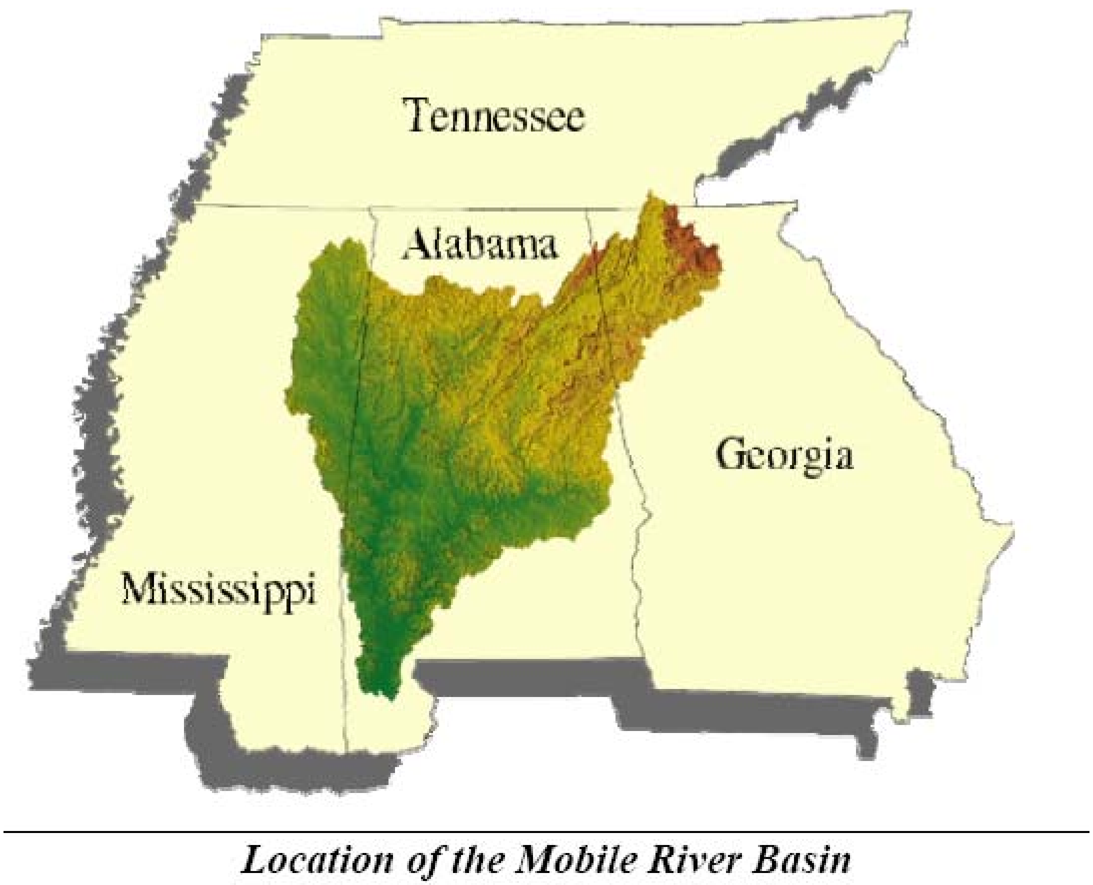


Figure A. Mobile Basin map (Tombigbee River Basin Management Plan Draft, 2005)

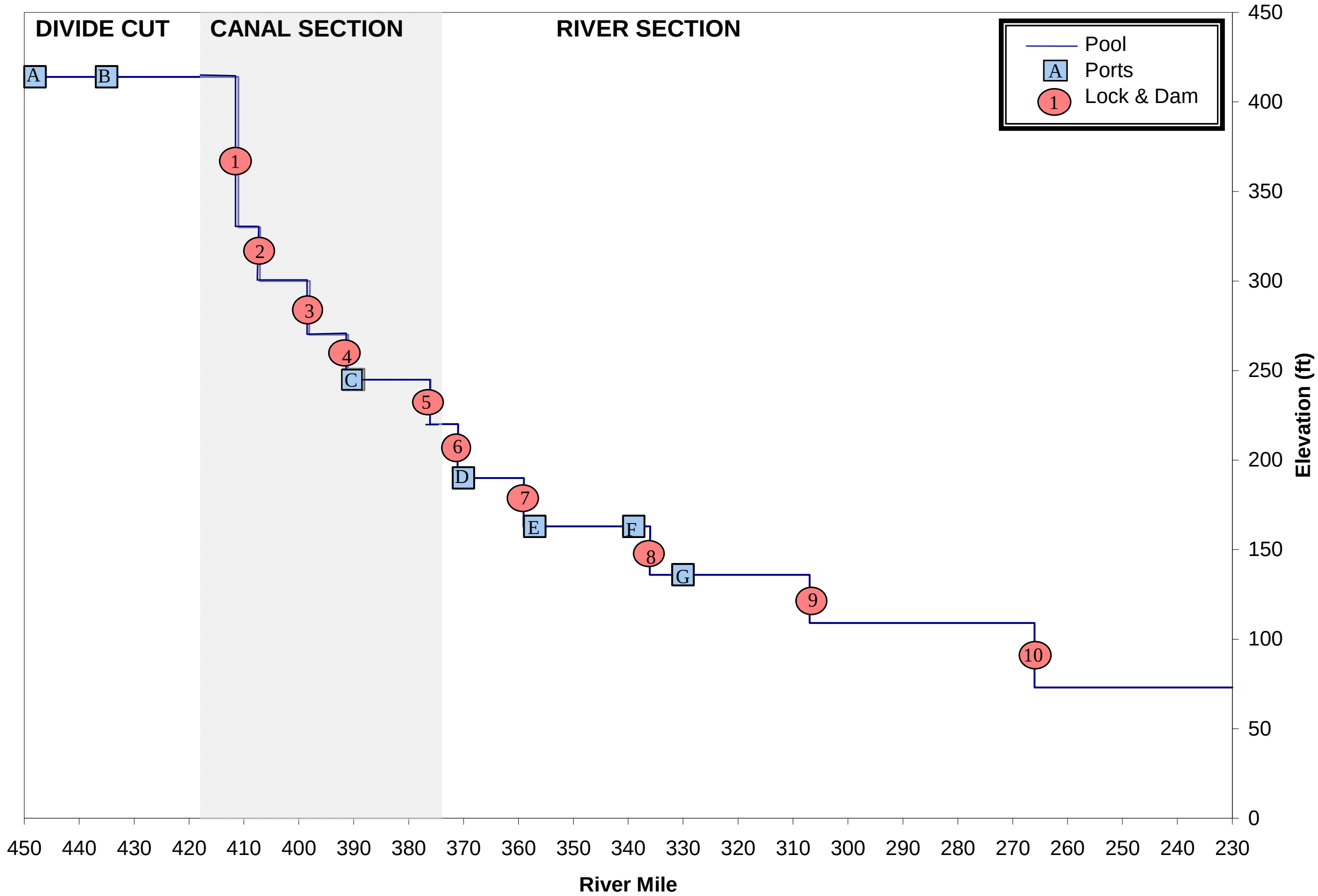
Figure B. Tennessee-Tombigbee Waterway Map (from www.tenntom.org)

Portions of the watershed in Mississippi are located in Itawamba, Lee, Monroe, Clay, Lowndes, Noxubee, Prentiss, Tishomingo, Union, Pontotoc, Chickasaw, Webster, Choctaw, Okitibbeha, Winston, and Kemper counties. Alabama counties located in part or in full in the watershed include: Lamar, Pickens, and Franklin, Marion, Fayette, Tuscaloosa, Greene, and Sumter counties. The Upper Tombigbee Basin drains about a 6,000 mi^2 area within Mississippi and includes six watersheds: Upper Tombigbee, Buttahatchee, Luxapallila, Middle Tombigbee-Lubbub, Sipsey, and Noxubee. The primary tributaries to the waterway include Browns Creek, Mackeys Creek, Twenty Mile Creek, Donivan Creek, Cummings Creek, Bull Mountain Creek, Mantachie Creek, Sipsey Creek, Town Creek, Weaver Creek, James Creek, Matubby Creek, McKinleys Creek, and the Buttahatchee River. The 2000 U.S. census estimated the entire Tombigbee River Basin has a population of 517,813 with 372,525 people living in the Mississippi portion, (Tombigbee River Basin Management Plan Draft, 2005).

The Tennessee-Tombigbee Waterway is a 234-mile-long inland waterway providing a navigation connection between the Tennessee River (and thus the Cumberland, Ohio, and Mississippi Rivers) and the Gulf of Mexico via the Black Warrior-Tombigbee Waterway and Mobile Bay. It passes through Mississippi and Alabama as shown in Figure B. Constructed by the U. S. Army Corps of Engineers, it was completed in 1984[1].

The Waterway consists of three distinct sections — River, Canal, and Divide Cut — as shown in Figure C. The River portion extends upstream from Mile 217, where the Waterway connects to the Black Warrior River, to Mile 366 near Amory, Mississippi, generally following the course of the Tombigbee River. The Canal section starts at Mile 366 and departs from the Tombigbee River course to trend generally northward to Jamie Whitten (Bay Springs) Lock and Dam at Mile 412. The Divide Cut section connects the Canal section to the Tennessee River at Pickwick Lake near the Mississippi-Tennessee boundary.

1 Information in this section was drawn from materials of the Corps of Engineers and the Tennessee-Tombigbee Waterway Development Authority and from a special issue of Environmental Geology and Water Sciences, Vol 7, Nos. 1/2, 1985. .



<u>PUBLIC PORTS</u> (River Mile)

A. Yellow Creek Port (448)
B. Burnsville Port (435)
C. Port Itawamba (390)
D. Amory Port (370)
E. Aberdeen Port (357)
F. Clay County Port (339)
G. Lowndes County Port (330)

<u>LOCK AND DAM</u>

1. Jamie Whitten (Bay Springs)
2. G.V. 'Sonny' Montgomery (Lock E)
3. John Rankin (Lock D)
4. Fulton (Lock C)
5. Glover Wilkins (Lock B)
6. Amory (Lock A)
7. Aberdeen
8. John C. Stennis (Columbus)
9. Tom Bevill (Aliceville)
10. Howell Heflin (Gainesville)

Figure C. Tenn-Tom Waterway Schematic (McAnally et al. 2004)

The 149-mile-long River section lies within the Tombigbee River flood plain and generally follows the course of the river. A number of river meanders have been cut off, leaving 71 miles of meander loops that are still connected to the Waterway. Four lock and dam structures raise the water level a total of 117 ft. The navigation channel has a bottom width of 300 ft and dredged depths of 9 or 12 ft plus 1 ft of allowable overdepth dredging. Numerous tributaries drain into the River section, bringing significant quantities of sediment.

The 46-mile-long Canal section is located near the eastern edge of the Tombigbee River floodplain and was formed by constructing a levee to serve as the western boundary of the section while natural high ground serves as the eastern boundary. Five pools result in a chain-of-lakes configuration to provide navigable depths with a 300-ft-wide by 12-ft-deep channel. Inflow to the Canal section is limited to discharges from Whitten Lock and Dam and small tributaries on the eastern edge of the floodplain. The Waterway Diverges from the Tombigbee River at Waterway Mile 366. The Tombigbee River above that point accumulates flow from the Big and Little Brown Creeks, Mackey's Creek, Donivan Creek, Twenty Mile Creek, and Mantachie Creek. Minimum flow structures on the waterway provide flow previously provided by Red Bud Creek, Bull Mountain Creek, Mackey Creek, and Turner Branch, also known as Standifer Creek. There is also a major input of water and sediment from the Donivan Creek Flood Control Project entering from the West.

The Divide Cut section connects the Tombigbee basin to the Tennessee River by an excavated cut through the basin divide extending 39 miles from Bay Springs Dam to Pickwick Lake. The navigation channel has a bottom width of 280 ft and a depth of 12 ft during minimum (winter) pool on Pickwick Lake. Inflows to the section consist of local inflows and flow from Pickwick Lake to replace water released downstream at Bay Springs Dam.

Table A lists the pools and structures of the Waterway and their dimensions. Each dam forms an upstream pool, which in some cases has the same name as the dam. Annual water flow through the Waterway consisting of natural flows plus estimated lockages per day are shown in Table B.

Table A. Tennessee-Tombigbee Waterway Navigation Components (McAnally et al, 2004)

Section	**Total Length (mi)**	**Channel Width (ft)**	**Channel Depth (ft)**	**Locks (Pool) 110 ft. wide x 600 ft. long each**	**Lift (ft)**	**Normal Pool Elevation (ft)**	**Water Surface (acres)**
River	149	300	9	Gainesville Lock and Dam (Gainesville)	36	109	6,400
				Bevill Lock and Dam (Aliceville)	27	136	8,300
				Stennis Lock and Dam (Columbus)	27	163	8,900
				Aberdeen Lock and Dam (Aberdeen)	27	190	4,121
Canal	46	300	12	Amory Lock (Pool A)	30	220	914
				Wilkins Lock (Pool B)	25	245	2,718
				Fulton Lock (Pool C)	25	270	1,642
				Rankin Lock (Pool D)	30	300	1,992
				Montgomery Lock (Pool E)	30	330	851
Divide	39	280	12	Whitten Lock (Bay Springs)	84	414	7,645
Total	234				341		43,483

Table B. Average Annual Flows, 1000 acre-ft (McAnally et al. 2004)

Pool	Upstream Inflow	Local Inflow	Discharge outside the Waterway
	301	270	0
Bay Springs	571	70	51
Pool E	590	32	15
Pool D	607	40	0
Pool C	647	447	163
Pool B	931	23	7
Pool A	947	1397	0
Aberdeen	2,744	2,494	0
Columbus	5,238	1,586	0
Aliceville	6,824	689	0
Gainesville	7,315	—	0

Although the Congressionally authorized purposes for the Waterway are limited to navigation, recreation, and wildlife mitigation, the Tenn-Tom Waterway also provides surface water supply to some in the region. Future growth is expected to intensify water supply needs and the Water Resources Development Act of 2007 (Section 4051) instructs the Corps of Engineers to perform a feasibility study for expanding the Waterway's authorized purpose to explicitly include water supply. However, before feasibility can be determined, watershed managers must first know the amount of water available in the system.

Scope

This report examines publicly available flow data to identify statistically relevant water discharges in the Tombigbee River and Tenn-Tom Waterway. While this study attempts to account for the major forcings in the Tenn-Tom Waterway Water Budget, it should be understood that not every drop of water entering or exiting the system can be accounted for but, "The challenge is to manage water resources while explicitly accounting for the inherent uncertainties in water budget estimates" (Healy, Et Al. 2007). For example, groundwater flows into and out of the Waterway are not considered here.

APPROACH

The overall approach consisted of compiling public water surface flow records and tabulating them in a Microsoft Excel spreadsheet, performing basic statistical analyses, and formatting the results.

The first step was to develop a conceptual understanding of how water moves through the system and to draw a schematic flow chart of the study area. Using maps from the Corp of Engineers Mobile District Office and Google Earth, a flowchart of significant tributaries was developed. Meetings with Waterway managers[2] refined the flow chart and improved our intuitive understanding of physical processes along the waterway, particularly issues with minimum flow structures and bypasses along the upper part of the Waterway. The resulting schematic flow chart of the system is presented in Figures D and E. The figure shows that pit dumps – the release of water from a navigation lock – at Whitten Lock supplies water to the Canal Section, as do several small streams on the east bank of the Waterway. At four locations in the upper Waterway flows are released through Minimum Flow Structures (MFS) into the former East Fork of the Tombigbee River. East Fork and Town Creek join to form the Tombigbee River, which flows into the Waterway at River Mile 366.

[2] The authors thank Rick Saucer, Allan Brewer, and Pete Grace of the Corps' Tenn-Tom Waterway Management Office for their expertise and insights.

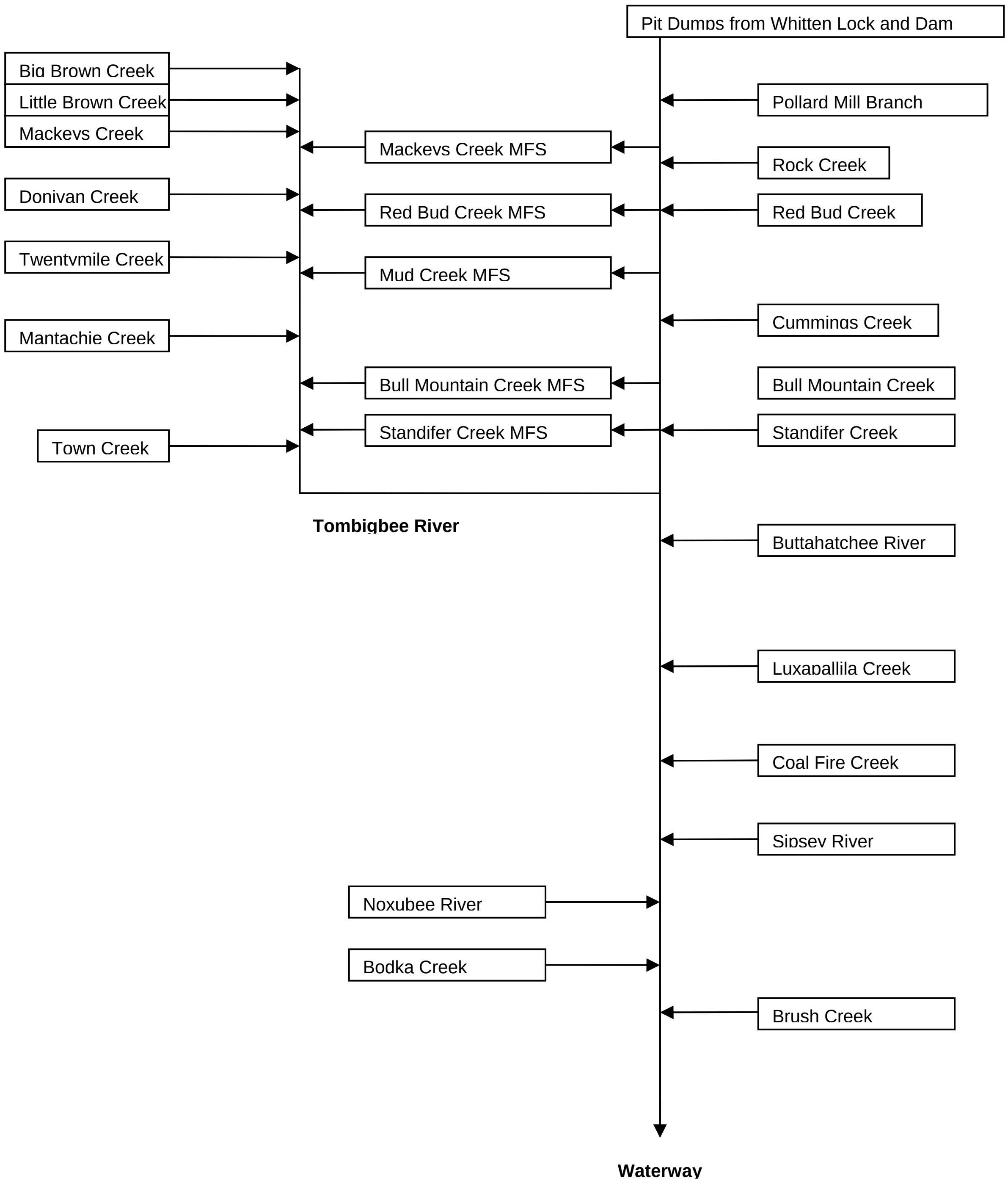


Figure D. Tombigbee River and Upper Tenn-Tom Waterway Flow Chart. (MFS= Minimum Flow Structure)

In order to begin to quantify the water budget, inflows and outflows from the watershed had to be gathered. Inflows to be gathered in the data collection included: tributary and in-stream flows, lockages, and permitted discharges in the study area, such as Publicly Owned Treatment Works (POTW). The data for streamflow were obtained from the United States Geological Survey water data webpage (http://waterdata.usgs.gov/nwis/rt) and analyses were conducted on an average annual basis. There were over 40 stream gaging stations located within the watershed, although not all gages were utilized. Stations having a very short period of record and upstream stations where there were multiple stations along a tributary were the most common reasons for omission. Table C lists the stations used in this analysis.

Table C. USGS Gaging Stations

Station Number	Station Name
02429900	BIG BROWN CREEK NR BOONEVILLE, MS
02429949	LITTLE BROWN CREEK NR NEW SITE, MS
02429980	POLLARD MILL BRANCH AT PADEN, MS
02430000	MACKEYS CREEK NR DENNIS, MS
02430038	ROCK CREEK NR BELMONT, MS
02430085	RED BUD CREEK NR MOORES MILL, MS
02430680	TWENTYMILE CREEK NR GUNTOWN, MS
02430880	CUMMINGS CREEK NR FULTON, MS
02431000	TOMBIGBEE RIVER NR FULTON, MS
02433500	TOMBIGBEE RIVER AT BIGBEE, MS
02436500	TOWN CREEK NR NETTLETON, MS
02437100	TOMBIGBEE RIVER AT ABERDEEN LOCK AND DAM, MS
02439400	BUTTAHATCHEE RIVER NR ABERDEEN, MS
02441390	TOMBIGBEE RIVER AT STENNIS LOCK AND DAM, MS
02443500	LUXAPALLILA CREEK NR COLUMBUS, MS
02444000	COAL FIRE CREEK NR PICKENSVILLE, AL
02444160	TOMBIGBEE RIVER AT BEVILL L&D NR PICKENSVILLE, AL
02444500	TOMBIGBEE RIVER NEAR COCHRANE, AL.
02446500	SIPSEY RIVER NR ELROD, AL
02447025	TOMBIGBEE R AT HEFLIN L&D NR GAINESVILLE AL
02448500	NOXUBEE RIVER NR GEIGER, AL
02448900	BODKA CREEK NEAR GEIGER, AL.
02431410	MANTACHIE CREEK BL DORSEY, MS
02433000	BULL MOUNTAIN CREEK NR SMITHVILLE, MS
02444490	BOGUE CHITTO CREEK NR MEMPHIS, AL
02467000	TOMBIGBEE R AT DEMOPOLIS L&D NEAR COATOPA, AL
02449245	BRUSH CREEK NR EUTAW, AL
02466030	BLACK WARRIOR RIVER AT SELDEN L&D NR EUTAW, AL

Lockages out of Whitten Lock and Dam are the major source of water for the Canal Section of the Tenn-Tom Waterway. Information on the number of Pit Dumps per Month since October 2003 was obtained from the Corp of Engineers. From this information, the average dumps per day were calculated. Next the volume of water passing through the lock during each lockage was determined by using the dimensions of the lock. James Whitten Lock and Dam measures six hundred and seventy (670) feet long and one hundred and ten (110) feet wide with a lift of eighty four (84) feet. This yields volumetric discharge during each lockage of six million one hundred and ninety thousand (6190000) cubic feet or one hundred and forty two (142) acre-feet. Couple with the average pit dumps per day being four point six (4.6) and the number of days in a year and the volumetric discharge in Acre*Feet per Year is obtained.

Surface water withdrawals in the Mississippi portion of the watershed were obtained through communication with Mississippi Department of Environmental Quality (MDEQ) and Alabama Department of Environmental Management (ADEM).[3] This data was a collection of surface water withdrawal permits with the pertinent data being the maximum volume of water a permit site could remove, in acre-feet per year, as well as latitude and longitude positioning. The majority of water taken from the Tenn-Tom Waterway is used in industrial water supply, public drinking water supply, and irrigation. Table D lists the permitted and pending permit withdrawals in Mississippi and Alabama.

Table D. Permitted and Pending Withdrawals in Mississippi

NAME	NUMBER	QUANTITY (ACRE*FT/YR)
TUMLINSON, J.H., AND	MS-SW-00079	400
TKACH LAND PARTNERSHIP	MS-SW-00082	250
KELLOGG, L. C., SR.	MS-SW-00090	225
KELLOGG, L. C., SR.	MS-SW-00093	225
NORTHEAST MISSISSIPPI REGIONAL WATER SUPPLY DIST.	MS-SW-00113	40331
JOST, JOHN C.	MS-SW-00135	210
CARTER, LARRY E.	MS-SW-00140	100
CARTER, LARRY E.	MS-SW-00141	200
COLUMBUS, CITY OF	MS-SW-00173	16805
WEYERHAEUSER COMPANY	MS-SW-01040	45171
COX, WILLIAM E.	MS-SW-01275	180
OLD WAVERLY GOLF CLUB LLC	MS-SW-01405	200
COLEMAN FARMS, INC.	MS-SW-01555	480
HOLLIMAN, GENE D.	MS-SW-01958	150
SCHROCK, TITUS	MS-SW-01971	75
WISE, C. A., ESTATE	MS-SW-01987	53

(continued)

[3] Celeste Evans and Tom Littlepage, respectively

Table D. Permitted and Pending Withdrawals in Mississippi (continued)

NAME	NUMBER	QUANTITY (ACRE*FT/YR)
HANEY, MARVIN Y.	MS-SW-02164	100
WALDROP, DUDLEY J. (WALDROP FARMS)	MS-SW-02498	225
WALDROP, D. D.	MS-SW-02499	175
WALDROP, D. D.	MS-SW-02500	175
HUSSEY, HERMAN E.	MS-SW-02520	70
HUSSEY, HERMAN E.	MS-SW-02521	70
AMORY, CITY OF	MS-SW-02575	50
PHILLIPS III, W R AND T L	MS-SW-02614	51
PILKINTON, SAMUEL T.	MS-SW-02750	350
SCHERTZ, JAY	MS-SW-02765	70
TODD, ELMER J., JR.	MS-SW-02768	36
TODD, ELMER J., JR.	MS-SW-02769	75
TOMBIGBEE LUMBER CO., INC.	MS-SW-02773	130
DOMTAR PAPER COMPANY LLC	MS-SW-02782	1290
ITAWAMBA COMMUNITY COLLEGE	MS-SW-02785	10
WRIGHT, DAVID T.	MS-SW-02793	1
PINKERTON, WAYNE	MS-SW-02794	1
STARKS, ROY D.	MS-SW-02796	1
TRULOVE, JOE	MS-SW-02800	4
COLEMAN, JOHNNIE B., MRS. (DOROTHY F.)	MS-SW-02827	1
GRAVLEE, MACON	MS-SW-02828	1000
LEATHERS, C. RICKEY	MS-SW-02842	1
GRANT, RANDALL	MS-SW-02846	1
MORRISON, JERRY	MS-SW-02858	1
SMITH, JAMES & JERRY	MS-SW-02860	1
NORTHEAST MS REGIONAL WATER SUPPLY DISTRICT	MS-SW-02869	33609
HAAS, FOX	MS-SW-02877	120
HAAS, FOX	MS-SW-02878	75
PATTERSON, KEARY	MS-SW-02891	200
RIEVES, HAL	MS-SW-02892	1
SMITH, C. W.	MS-SW-02897	1
KORNFUHRER, HAROLD & VICKI	MS-SW-02899	1
SMITH, DANNY LEE & BEVERLY	MS-SW-02900	1
DYE, WALTER	MS-SW-02901	2
NIX, GEORGE BURTON, JR.	MS-SW-02918	50
COOPER MARINE AND TIMBERLANDS	MS-SW-03028	20
SHIRLEY, WILLIAM T	MS-SW-03171	8
SKELTON, STEVE	AL-SW-1188	373
COOPER MARINE & TIMBERLANDS	AL-SW-1180	557
VIENNA SOD LLC	AL-SW-1185	61
FORKLAND SPRINGS FARM	AL-SW-865	0
PATTON FARM SOUTH	AL-SW-550	27

Discharges within the watershed were much more difficult to obtain than surface water withdrawals. A comprehensive spreadsheet of dischargers within the basin was not available through MDEQ or ADEM. This presented the opportunity to explore a different manner of data acquisition. The process began with the use of Geographic Information Systems (GIS) tools and map representation. A shapefile of the permitted dischargers in the watershed was found at the Mississippi Automated Resource Information System, or MARIS, website (http://www.maris.state.ms.us/). When this shapefile is added to a map layer of perennial streams and stream gages it becomes possible to obtain the locations and names of dischargers which are pertinent to the study. The names under which the permits are filed are then searched in MDEQ's EnSearch engine (http://opc.deq.state.ms.us/) of permits within the state and in most cases provided a permitted volumetric discharge for each location. Of the times when volumetric discharges were not obtained, one of the impediments was the permits which do not state a quantitative discharge but a maximum and minimum concentration or pH for which effluents must not exceed. In some other cases, sites were still in the process of being permitted or were not found in the database. But many dischargers in the area were permitted a maximum quantitative discharge which could be used in the study. The majority of discharges to the Waterway included publicly-owned treatment works (POTW) and industrial sites. Sites that simply replace water taken from the Waterway represent little to no change in Waterway flow; however, those dischargers using groundwater as their water supply increase flow in the Waterway.

Figure F displays the spatial and relative location of the permitted sources and sinks of water in the study area. These flows plus the gaged river flows were compiled into a spreadsheet which calculates the water budget for various standard statistical measures.

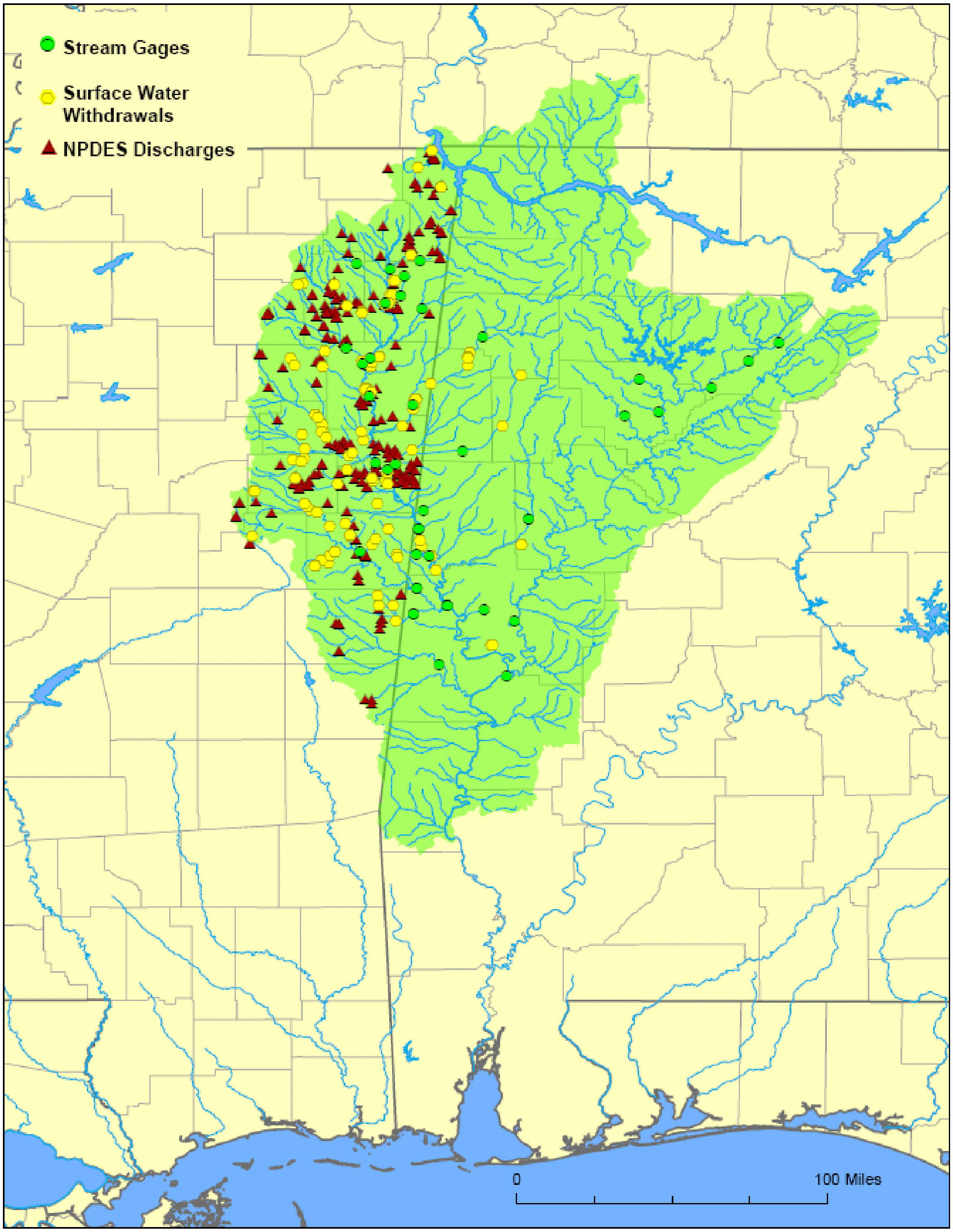


Figure F. Study Area Map

After all of the data had been gathered and arranged and ordered in a spatially significant way, several statistical analyses were performed by changing the streamflow conditions. Three cases were analyzed: Mean, Low, and High Flow. The mean flow condition was obtained through averaging the mean annual flows, as obtained from the USGS, and averaging those values over the period of record of each gage. In the low flow simulation, it was decided that a 7Q10 low flow approach would be used to describe the low flow situation. A 7Q10 is a measure of streamflow which describes the lowest flow for seven consecutive days that is expected to occur once in ten years. A program distributed by the Environmental Protection Agency (EPA) named DFLOW was used to perform the 7Q10 calculations. DFLOW was developed by the U.S. EPA Standards and Health Protection Division by the Great Lakes Environmental Center and Limno-Tech Inc. It is a Windows-enabled program that follows the methodology for stream design flow for steady-state modeling. The high flow simulation was chosen to represent a $Q_{1.5}$ discharge. This is considered a bank-full discharge which has a return interval of one and half years. It may also be referred to as dominant discharge, effective discharge, and channel-forming discharge. This type of flow is most often used in sedimentation studies but can be used equally well in this situation. A program called PeakFQ was used to determine the discharge of rivers and creeks during high flow events. PeakFQ performs statistical flood-frequency analyses of annual peak flows following procedures recommended in Bulletin 17B of the Interagency Advisory Committee on Water Data.

RESULTS

A primary end product of this work is the spreadsheet described in the preceding section. The spreadsheet, provided separately, is shown in a sample screen shot in Figure G.

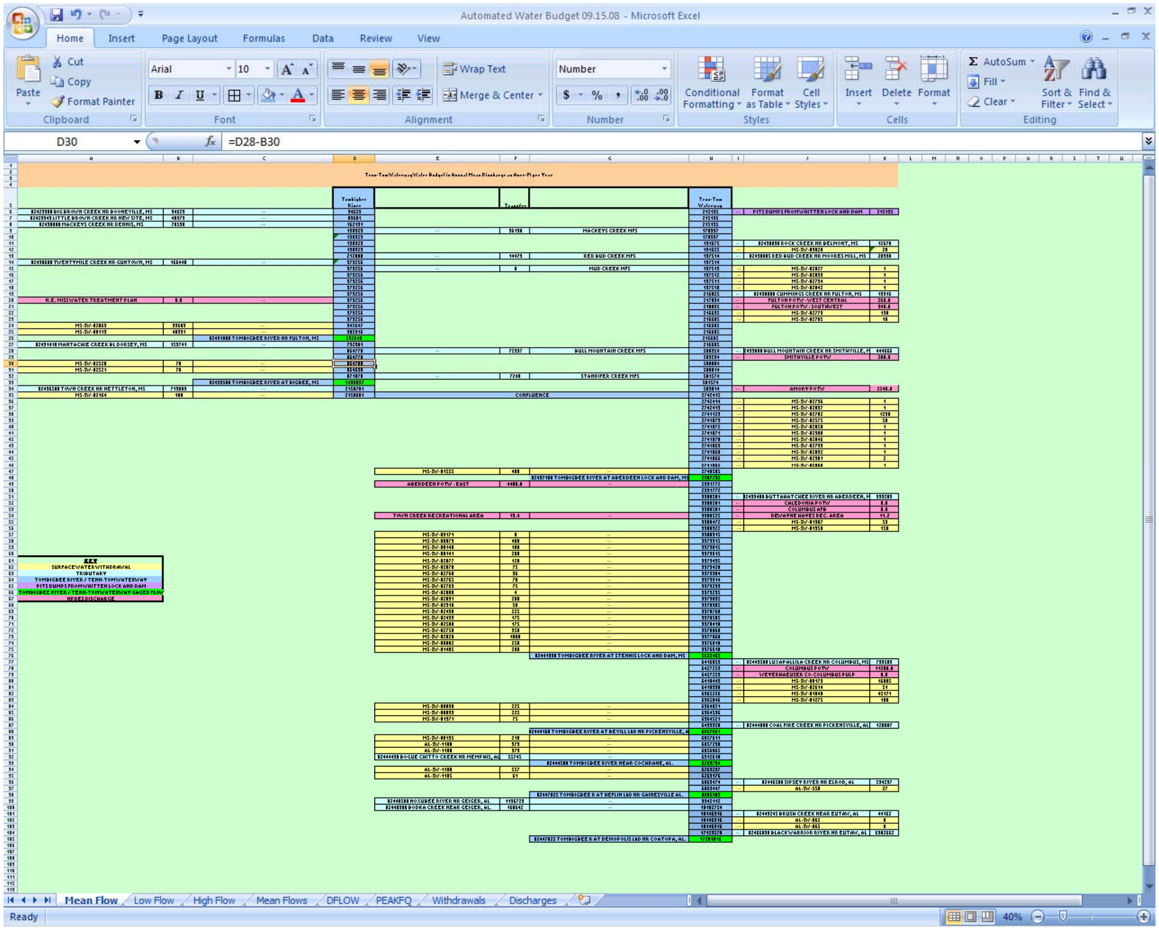


Figure G. Water Budget Spreadsheet Sample Screenshot

In the above pictured spreadsheet, yellow cells represent withdrawals, pink cells stand for discharges, light blue cells signify a tributary, and dark blue cells indicate the run of the river or waterway. Some cells in the river and waterway are green. This connotes a measured flow in the river or waterway. Most of the dark blue cells values are derived through addition or subtraction of water from the system, but the green cells are measured flows. This can appear to cause some incongruence but this is just an artifact of limited statistical information and differences in the period of record for stream gages throughout the system. An example initially occurred at the Tombigbee River Gage near Cochrane Alabama. The volumetric flow as measured by the gage was lower than it should have been. The period of record for this gage was from 1938 to 1978. This means that the gage could not capture the hydrologic conditions of the river after the construction of the Tenn-Tom Waterway. The addition of Tennessee River water to the system must have caused an increase in flow of the system and therefore this gage is expected to provide a statistical flow which is less than the actual flow at that point of the waterway. It is for these reasons and the fact that there are gages located closely upstream and downstream of the Cochrane gage that the gage was excluded from the study.

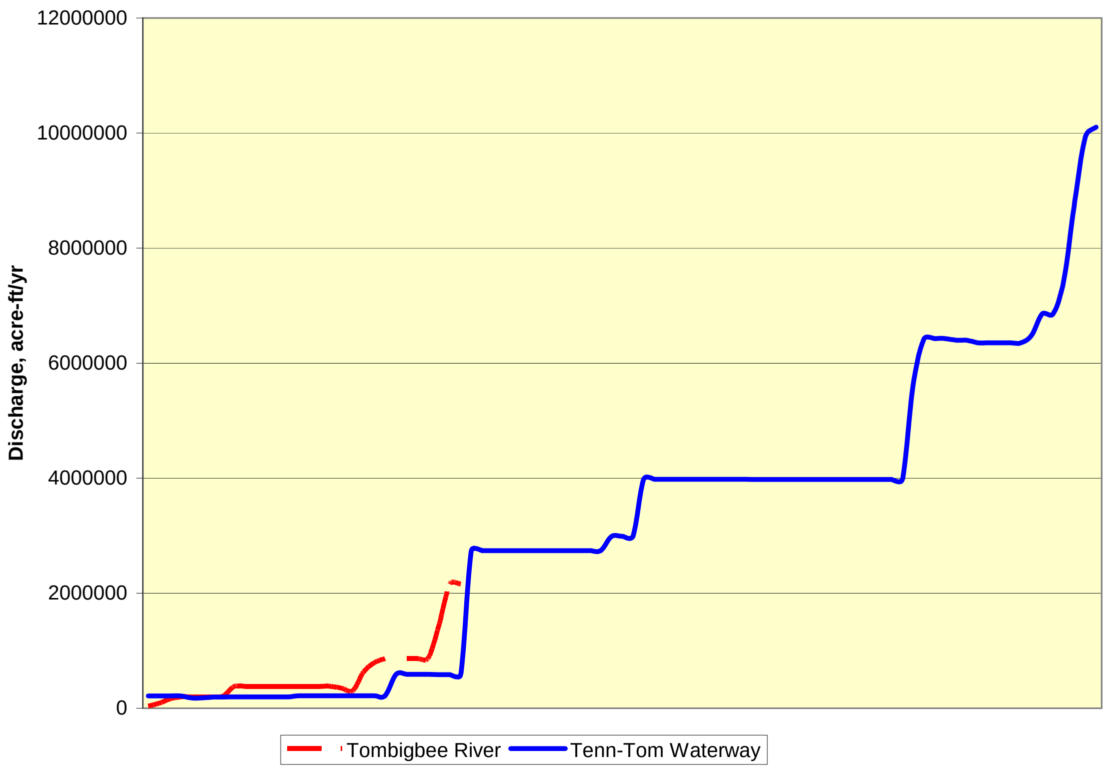


Figure H. Mean Flow Results with Distance down River

One issue with the results is the use of a 7Q10 analysis over the entire watershed. A 7Q10 event over that large of an area is extremely unlikely to occur because of the size of the watershed and low probability of occurrence for each stream within the area. It is more likely that only a portion of streams will be experiencing a 7Q10 type of flow while other streams maybe just a little below average. Of course, the possibility of a widespread drought situation could occur, as witnessed by the droughts across the Southeast is the past few years. Another problem encountered during the statistical analysis was lack to data. The stream gages from Mantachie, Rock, and Bull Mountain Creek did not have enough data in order to perform the statistical flow analysis. They all had a long enough period of record but the data was not continuous throughout the lifetime of the gage and therefore it was not advisable to try to calculate the high and low flow events. These two considerations should be recognized when examining the low and high flow scenarios of the study.

CONCLUSIONS

There is a need to understand the sources and withdrawals of water entering the watershed and their potential impacts on flows in the Tombigbee and Tennessee River Basins. The need is to protect the ecological, economic, and cultural health of the watershed. Recent issues over state water rights highlight the need for an effective and accessible water budget so watershed managers can make well-informed decisions when permitting withdrawals and discharges in the watershed. Without knowing how much water is present in the system it is very dangerous to permit water use as it would be possible to pledge water which may not be available in drought situations. As a recent report on water budgets by the United State Geological Society (USGS) says, “Balancing the water needs of humans with those of natural biological resources is an emerging area of concern for reservoir operation” (Healy, et al. 2007). With the formation of the Tenn-Tom Waterway, the river ceased to be a free flowing stream dominated by oscillations in natural weather patterns but a connected series of pools, which must be appropriately and effectively controlled by well informed water resources managers. With the development and growth in Northeast Mississippi, excessive water use in the upper part of the basin must not threaten the physical and biological resources of the downstream watershed, Mobile Bay, Mississippi Sound, and the Gulf of Mexico.

Watershed managers must consider community and industrial growth water supply needs in light of the health of the entire system, including down to Mobile Bay and the Gulf of Mexico. With this knowledge and viewpoint, permitting withdrawals in the area becomes a challenge that must not be considered on a state by state basis but with a watershed perspective that will balance economic and social growth with ecological integrity and environmental sustainability.

Political boundaries, such as state lines, are immaterial to the functioning of ecosystems but they made it more difficult gathering data for this study. For instance, information concerning volumetric discharges in Alabama was going to be included, but because of permitting information being kept on a state by state basis and other considerations that information was not included in the study. It would be much more helpful for the scientific and management community if data were kept and organized by considering natural environmental boundaries, such as watersheds, and not by political boundaries.

One of the most obvious areas of need in this water budget is information for ungaged streams and creeks. There are several considerable inputs to the system, which are not gaged by the USGS. Donivan Creek is a major input of water volume and sediment load from the West to the Tombigbee River. An estimation of the contributions of this stream and others would be helpful in assembling a more complete picture of the water budget in the study area. These ungaged flows can be estimated by finding the average flow contribution per acre for the streams with data in the watershed and applying that average to the ungaged streams and their contributing areas. This should provide a ballpark estimate of the water contributed by streams for which we have very little information. Another improvement to the results would the use of a probability function to determine a portion of streams in the area which would be experiencing low or high flows and thereby giving use a better characterization of the activity of the entire system under extreme conditions. Still better will be to complement this work with a hydrologic model simulation of the basin for long time periods to generate input data for the analyses.

References

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