NO. 139, ORIGINAL

In The
Supreme Court of the United States

THE STATE OF MISSISSIPPI,

Plaintiff,

v.

THE CITY OF MEMPHIS, TENNESSEE,
MEMPHIS LIGHT, GAS & WATER DIVISION,
AND THE STATE OF TENNESSEE,

Defendants.

On Motion for Leave to File Bill of Complaint in Original Action

THE STATE OF MISSISSIPPI'S MOTION FOR LEAVE TO FILE BILL OF COMPLAINT IN ORIGINAL ACTION, COMPLAINT, AND BRIEF IN SUPPORT OF MOTION

John W. (Don) Barrett
David M. McMullan, Jr.
Barrett Law Office, P.A.
404 Court Square North
Post Office Box 987
Lexington, MS 39095
(662) 834-2376

Alan B. Cameron
Counsel of Record
Larry D. Moffett
Daniel Coker Horton & Bell, P.A.
Oxford Square North
265 North Lamar Blvd., Suite R
Post Office Box 1396
Oxford, MS 38655
(662) 232-8979

Counsel for Plaintiff

September 2, 2009

Becker Gallagher · Cincinnati, OH · Washington, D.C. · 800.890.5001

Geoffrey C. Morgan
George W. Neville
Mississippi Attorney
General's Office
Walter Sillers State
Office Building
Suite 1200
550 High Street
Jackson, MS 39201
(601) 359-3680

C. Michael Ellingburg
Daniel Coker Horton &
Bell, P.A.
4400 Old Canton Road
Suite 400
Post Office Box 1084
Jackson, MS 39215-1084
(601) 969-7607

George B. Ready
George B. Ready Attorneys
Post Office Box 127
Hernando, MS 38632
(662) 429-7088

Counsel for the
State of Mississippi

TABLE OF CONTENTS

In the
Supreme Court of the United States

No. _____, Original

THE STATE OF MISSISSIPPI,
Plaintiff,

v.

THE CITY OF MEMPHIS, TENNESSEE,
MEMPHIS LIGHT, GAS & WATER DIVISION,
AND THE STATE OF TENNESSEE
Defendants.

MOTION FOR LEAVE TO FILE BILL OF COMPLAINT IN ORIGINAL ACTION

The State of Mississippi ("Mississippi"), pursuant to Supreme Court Rule 17, moves this Court for leave to file its Complaint against the City of Memphis, Tennessee ("Memphis"), its utility division, Memphis Light, Gas & Water ("MLGW"), and the State of Tennessee ("Tennessee"), for the reasons stated in the accompanying Brief in Support.

Mississippi has filed its Petition for Writ of Certiorari to the U.S. Court of Appeals for the Fifth Circuit contemporaneously with this Motion. In the event this Court does not grant Mississippi's petition and reverse the Fifth Circuit's opinion and judgment sought to be reviewed, Mississippi respectfully requests this Honorable Court to grant this motion and allow the filing of the Complaint annexed hereto.

Respectfully submitted,

John W. (Don) Barrett
David M. McMullan, Jr.
Barrett Law Office, P.A.
404 Court Square North
Post Office Box 987
Lexington, MS 39095
(662) 834-2376

George B. Ready
George B. Ready
Attorneys
Post Office Box 127
Hernando, MS 38632
(662) 429-7088

Geoffrey C. Morgan
George W. Neville
Mississippi Attorney
General's Office
Walter Sillers State
Office Building
Suite 1200
550 High Street
Jackson, MS 39201
(601) 359-3680

Alan B. Cameron
Counsel of Record
Larry D. Moffett
Daniel Coker Horton &
Bell, P.A.
Oxford Square North
265 North Lamar Blvd.,
Suite R
Post Office Box 1396
Oxford, MS 38655
(662) 232-8979

C. Michael Ellingburg
Daniel Coker Horton &
Bell, P.A.
4400 Old Canton Road,
Suite 400
Post Office Box 1084
Jackson, MS 39215-
1084

Counsel for the
State of Mississippi

September 2, 2009

In the
Supreme Court of the United States

No. _____, Original

THE STATE OF MISSISSIPPI,
Plaintiff,

v.

THE CITY OF MEMPHIS, TENNESSEE,
MEMPHIS LIGHT, GAS & WATER DIVISION
AND THE STATE OF TENNESSEE
Defendants.

COMPLAINT

The State of Mississippi, by its Attorney General, Jim Hood, brings this suit against the City of Memphis, Tennessee, Memphis Light, Gas & Water Division and the State of Tennessee, and for its cause of action states as follows:

INTRODUCTION

1. The Memphis Sand or "Sparta" Aquifer ("the aquifer") is a five hundred to eight hundred ninety foot thick formation or stratum of permeable sand, rock and gravel confined between clay layers below the surface of lands situated in the northwest part of the State of Mississippi ("Mississippi") and the western part of the State of Tennessee ("Tennessee"). Naturally stored in the sand formation for thousands of years is ground water considered to be among the best water resources in the United States. This action arises from the wrongful transboundary diversion and

unlawful taking and conversion of the aquifer ground water underlying and owned by Mississippi, which diversion, taking and conversion is caused by the municipal well pumping and water sales operations of the City of Memphis, Tennessee ("Memphis"), and its wholly-owned division, Memphis Light, Gas & Water ("MLGW").

2. The formation comprising the aquifer spans a subterranean area between Mississippi and Tennessee, although the ground water stored in the dense sands is not a natural resource shared between these states. Rather, Mississippi and Tennessee separately own and control the valuable ground waters within their respective sovereign borders. Neither state has dominion over the other's resources. Mississippi and Tennessee were apportioned or allocated their discrete respective shares of the ground water stored in the sand formation upon attaining statehood as a fundamental, self-evident attribute of sovereignty.

3. The ground water beneath Mississippi is the primary source of water supply for Desoto County, Mississippi, providing valuable high quality water for residential and commercial uses in that rapidly developing area of the State. Just across the state line, Defendants Memphis and MLGW operate a tremendous artesian water pumping and distribution system with more than one hundred seventy-five wells in ten large wellfields supplying over two hundred million gallons of ground water daily to Memphis and MLGW's other customers. MLGW's pumping has created a geophysical feature called a "cone of depression" in the aquifer centered under Memphis and expanded deeply into north Mississippi. The cone

siphons and diverts over twenty-four million gallons of ground water each day from under Mississippi into storage under Memphis to supply MLGW's wells.

4. The diverted ground water is being artificially siphoned from Mississippi and into Memphis through the mechanical operation of MLGW's wells, not by natural forces. The diverted ground water would never under normal, natural circumstances have migrated across the state line into Memphis, or anywhere else in Tennessee. But for the actions of Memphis and MLGW, the diverted quantities of ground water would still be contained within Mississippi's borders. More than three hundred sixty-three billion gallons, approximately 15-22% of Memphis' water supply, has been wrongfully taken from Mississippi from 1965 to 2006, and the massive continuing diversions exceed twenty-four million gallons daily, or 8.54 billion gallons annually.

5. As remedies for these past and continuing pumping-induced diversions, Mississippi brings this action to obtain the following relief:

(a) Mississippi seeks an award of monetary damages against Memphis and MLGW equal to the value of Mississippi's water diverted and wrongfully taken. Such damages, plus equitable or prejudgment interest (accrued through 2007), are in a range of $980 million to $1.23 billion for ground water diverted, taken and converted from 1965 through 2006. For periods from 2007 through 2017, Mississippi anticipates additional damages ranging from $105 million to

$160 million (exclusive of interest). *See Kansas v. Colorado*, 533 U.S. 1, 6, 8-10 (2001).

(b) Mississippi seeks an injunction requiring Memphis and MLGW to timely take all financial, operational or other actions necessary to cease their diversion and wrongful taking of Mississippi's ground water. *See Wisconsin v. Illinois & Sanitary Dist. of Chicago*, 278 U.S. 367, 420-21 (1929).

(c) Alternatively, and *if and only if* this Court determines that Mississippi does not own and control the ground water resources within its borders and that the aquifer ground water must be apportioned or allocated between Mississippi and Tennessee in a manner different from the inherent apportionment that occurred upon the States' attainment of statehood, then Mississippi requests this Court to (i) adjudicate the parties' dispute, (ii) determine the equitable apportionment of the ground water contained in the aquifer, (iii) award Mississippi monetary damages against Memphis and MLGW for any past diversions and takings of ground water by Memphis and MLGW that are inconsistent with the Court's apportionment; and (iv) enjoin Memphis and MLGW from future diversions and takings of ground water in a manner

inconsistent with the Court's apportionment.

PARTIES

6. Plaintiff, Mississippi, is a sovereign State of the United States. Mississippi owns the ground water located or residing within its territorial boundaries.

7. Mississippi brings this suit in its capacity as sovereign and as *parens patriae* for its citizens.

8. Defendant MLGW, the nation's largest water, gas and electric utility, is a division of Defendant Memphis, a political subdivision of Tennessee. These Defendants may be served with process by delivery and service of a summons and Complaint upon MLGW's President and Chief Executive Officer, and upon Memphis' Mayor in the manner provided in Supreme Court Rule 29.

9. Tennessee is a sovereign State of the United States. Tennessee owns the ground water located or residing naturally within its territorial boundaries.

10. Tennessee may be served with process under Supreme Court Rule 29 by delivery and service of a summons and this Complaint upon its Governor and Attorney General as required by Supreme Court Rule 17.

JURISDICTION AND VENUE

11. The exclusive and original jurisdiction of this Court over controversies between two States[1] and involving two non-state parties is invoked, provisionally, under Article III, Section 2, clause 2 of the United States Constitution and 28 U.S.C. §§1251 (a) & (b)(3).

THE DIVERSION AND CONVERSION OF MISSISSIPPI'S GROUND WATER RESOURCES BY MEMPHIS AND MLGW

12. The aquifer, whose distinct portions underlie northwest Mississippi and western Tennessee, consists of a five hundred foot thick layer of very fine to very coarse sand interlaced with beds of clay and silt, and is an optimum source of high-quality water supply for a variety of residential and commercial uses. Only ground water originally residing, or now residing, within Mississippi's sovereign borders is at issue in this dispute.

---

[1] Mississippi originally filed its action in U.S. District Court against Defendants Memphis and MLGW only under 28 U.S.C. §§1331 and *Illinois v. Milwaukee*, 406 U.S. 91 (1972). In trial court proceedings, however, Memphis and MLGW claimed that Tennessee's sovereign interests were implicated, a position first rejected and then later adopted *sua sponte* by the District Court on the eve of trial. Mississippi appealed and the Fifth Circuit affirmed. Tennessee, appearing *amicus curiae* in the appeal, asserted its sovereign powers to the extent Mississippi's claims affect ground water within Tennessee's borders. Thus, Mississippi has provisionally filed this original action under Supreme Court Rule 17 for the reasons expressed in Mississippi's Motion for Leave to File Bill of Complaint in Original Action and supporting brief filed contemporaneously herewith.

13. The aquifer underlying Mississippi is a deep subterranean sand formation confined between clay layers containing a reserve of pure ground water that has been trapped and stored for thousands of years in the dense sands within Mississippi's present borders. This ground water takes thousands of years to replenish as its movement is naturally restricted by the porosity and friction of the constituents of the geology. Under natural conditions, the same geological factors created a similar but separate reserve of ground water naturally stored beneath Tennessee.

14. Mississippi's ground water in the aquifer is essentially a static resource, naturally filtered by "moving" imperceptibly in the sands. Unless it is disturbed by stresses, such as MLGW's pumpage, the subject ground water stays in a static or steady-state condition with a constant volume of water being always present and contained within the territorial boundaries of Mississippi. In fact, but for MLGW's pumping-induced diversions, the ground water diverted by Memphis and MLGW would still reside in Mississippi and would have never crossed the state line or otherwise become commingled with Tennessee's ground water resources.

15. The natural path of ground water movement within Mississippi was, prior to MLGW's pumping operations, east to west through pore spaces (between sand and rock against friction) at a rate imperceptible to humans. The diverted ground water was confined and stored for millennia beneath lands that became encompassed within Mississippi's sovereign borders upon Mississippi's attainment of statehood.

16. MLGW's pumping has created a cone of depression that has crossed the Mississippi-Tennessee state border into Mississippi, forever altering the natural steady-state condition of Mississippi's ground water. The movement of Mississippi's ground water has been permanently changed from its natural east to west direction and imperceptibly slow rate to a northward direction, moving by artificial siphoning and mechanical ground water pumping and extraction methods at an accelerated rate toward the steepest part of the cone underlying Memphis to supply MLGW's wells.

17. Since at least 1965, independent federal and state ground water scientists and experts from the United States Geological Survey ("USGS") and the University of Memphis Ground Water Institute ("GWI") have recorded and reported the cone's existence and the resulting aquifer drawdown and huge diversions of ground water from Mississippi into the Memphis area. These scientific publications have, over decades, uniformly confirmed MLGW's permanent alteration in natural flow path and rate of movement of Mississippi's ground water.

18. In the mid-1990's, representatives of the Mississippi Department of Environmental Quality ("MDEQ") contacted officials at MLGW to arrange for a joint, cooperative study of the ground water diversion problem. The MDEQ urged cooperation from Memphis and MLGW in studying the issues to find a physical solution to the problem, but they declined to participate.

19. In the late 1990's, the Memphis news media published articles confirming these scientists and

regulatory authorities, reporting that heavy pumping of municipal wells in Memphis had diverted the flow of Mississippi's ground water, creating a cone of depression that pulled Mississippi's ground water from the south in a northward direction toward Memphis' pumping centers, providing over 20% of Memphis' water supply. Contemporaneously, the Tennessee Department of Environment and Conservation ("TDEC") commissioned a legal and water management policy study of MLGW's pumpage and the effect of the tremendous cone of depression on north Mississippi. In June 2000, a report evaluating the potential liability of Memphis and MLGW to Mississippi was presented to senior officials of Memphis, MLGW and TDEC. Still, no action was taken to mitigate the diversions.

20. In March 2002, the Tennessee Comptroller's Office prepared a special report directed to Tennessee's legislature advising of the serious ground water diversions caused by MLGW's pumpage and the need for a prompt legislative or regulatory response. No action was taken to cease or mitigate the past and continuing diversions.

21. Memphis and MLGW have been diverting and capturing Mississippi's ground water on a continual basis for many years. Over three hundred sixty-three billion gallons of Mississippi's ground water have been permanently diverted and wrongfully taken and converted from Mississippi by Memphis and MLGW during the forty year period from 1965 through 2006. The conversion of Mississippi's ground water is ongoing; the present level of Memphis' diversions, at some twenty-four million gallons each day, are expected to continue until 2017.

22. Absent total cessation of MLGW's pumpage, Memphis' and MLGW's conversion of Mississippi's ground water will continue for the foreseeable future life of the aquifer. Because of the alteration of the ground water system, even if MLGW were to completely cease pumping from its wells, the ground water already wrongfully diverted by Memphis and MLGW into Tennessee from Mississippi will not return to Mississippi. MLGW's cessation of pumping will simply mitigate additional future diversions.

23. Once Mississippi's ground water is diverted by MLGW and Memphis it becomes captured within Memphis' hydrologic ground water inventory, and there is a continuous, ongoing process in which water that reaches MLGW's wells or well fields is constantly being replaced by water being continually taken from Mississippi. The quantities of Mississippi's ground water diverted and taken by Memphis have, therefore, become permanently incorporated into Memphis' ground water supply inventory or "budget" and have been permanently lost by Mississippi.

24. The actions of Memphis and MLGW constitute an unlawful present and continuing physical invasion and willful, intentional trespass upon Mississippi's valuable water resources. Memphis and MLGW are, and have been, exercising unlawful control and dominion over Mississippi's ground water through their wrongful diversion, taking and conversion of state-owned natural resources. Memphis and MLGW have been unjustly enriched to the ultimate detriment of Mississippi and its citizens.

PRAYER FOR RELIEF

WHEREFORE, the State of Mississippi prays for an award of monetary damages and injunctive or other relief as set forth in Paragraph 5. (and subparts) of this Complaint. Mississippi also respectfully requests the Court to grant such other or further relief to which Mississippi, in equity and good conscience, may be entitled.

Respectfully submitted,

Alan B. Cameron
Counsel of Record
Larry D. Moffett
Daniel Coker Horton & Bell, P.A.
Oxford Square North
265 North Lamar Blvd., Suite R
Post Office Box 1396
Oxford, MS 38655
(662) 232-8979

C. Michael Ellingburg
Daniel Coker Horton & Bell, P.A.
4400 Old Canton Road, Suite 400
Post Office Box 1084
Jackson, MS 39215-1084

John W. (Don) Barrett
David M. McMullan, Jr.
Barrett Law Office, P.A.
404 Court Square North
Post Office Box 987
Lexington, MS 39095
(662) 834-2376

Geoffrey C. Morgan
George W. Neville
Mississippi Attorney
General's Office
Walter Sillers State
Office Building
Suite 1200
550 High Street
Jackson, MS 39201
(601) 359-3680

George B. Ready
George B. Ready
Attorneys
Post Office Box 127
Hernando, MS 38632
(662) 429-7088

Counsel for the
State of Mississippi

September 2, 2009

No. 09-_____, Original

In the
Supreme Court of the United States

THE STATE OF MISSISSIPPI,
Plaintiff,

v.

THE CITY OF MEMPHIS, TENNESSEE,
MEMPHIS LIGHT, GAS & WATER DIVISION,
AND THE STATE OF TENNESSEE
Defendants.

On Motion for Leave to File Bill of Complaint in Original Action

THE STATE OF MISSISSIPPI'S BRIEF IN SUPPORT OF MOTION FOR LEAVE TO FILE BILL OF COMPLAINT IN ORIGINAL ACTION

John W. (Don) Barrett
David M. McMullan, Jr.
Barrett Law Office, P.A.
404 Court Square North
Post Office Box 987
Lexington, MS 39095
(662) 834-2376

Alan B. Cameron
Counsel of Record
Larry D. Moffett
Daniel Coker Horton & Bell, P.A.
Oxford Square North
265 North Lamar Blvd., Suite R
Post Office Box 1396
Oxford, MS 38655
(662) 232-8979

Geoffrey C. Morgan
George W. Neville
Mississippi Attorney
General's Office
Walter Sillers State
Office Building
Suite 1200
550 High Street
Jackson, MS 39201
(601) 359-3680

C. Michael Ellingburg
Daniel Coker Horton &
Bell, P.A.
4400 Old Canton Road,
Suite 400
Post Office Box 1084
Jackson, MS 39215-
1084

George B. Ready
George B. Ready
Attorneys
Post Office Box 127
Hernando, MS 38632
(662) 429-7088

Counsel for the
State of Mississippi

September 2, 2009

QUESTIONS PRESENTED FOR REVIEW IN ORIGINAL ACTION

Whether Plaintiff, the State of Mississippi, may recover an award of monetary damages and prejudgment or equitable interest and obtain injunctive relief against Defendants, the City of Memphis, Tennessee and its utility division, Memphis Light, Gas & Water, for the conversion of hundreds of billions of gallons of aquifer ground water owned by Mississippi in this original action under 28 U.S.C. Section 1251(b)(3).

Alternatively, *and only in the event* this Court denies Mississippi's Petition for Writ of Certiorari filed contemporaneously herewith, whether Plaintiff, Mississippi, may invoke this Court's original and exclusive jurisdiction under 28 U.S.C. Section 1251(a) to obtain against Defendant, the State of Tennessee, a decree of equitable apportionment of the ground water owned by the states of Mississippi and Tennessee and residing within their separate respective sovereign borders and (a) an award of monetary damages against Defendants, the City of Memphis, Tennessee and Memphis Light, Gas & Water Division, for any past diversions and takings of Mississippi's ground water and (b) an order enjoining the City of Memphis, Tennessee and Memphis Light, Gas & Water Division from continuing and future diversion and wrongful taking of ground water located or residing within Mississippi's borders in a manner inconsistent with this Court's apportionment.

TABLE OF CONTENTS

TABLE OF AUTHORITIES

Cases

Constitutional Provisions

Statutes

Other Authorities

INTRODUCTION

PREAMBLE

In this Original Action, Plaintiff, the State of Mississippi ("Mississippi"), seeks recovery of monetary damages and injunctive relief against Defendants, the City of Memphis, Tennessee ("Memphis") and its utility division, Memphis Light, Gas & Water ("MLGW") for conversion of Mississippi's ground water. The action is being filed under the original, but not exclusive, jurisdiction of the Court over actions between a state and a citizen of another state. 28 U.S.C. §1251(b)(3). For the reasons stated below, jurisdiction is also asserted under the original and exclusive jurisdiction of the Court over actions between states. 28 U.S.C. §1251(a).

The action was originally filed in the United States District Court for the Northern District of Mississippi under that court's federal question jurisdiction. 28 U.S.C. §1331(a); *Illinois v. Milwaukee*, 406 U.S. 91 (1972). At the commencement of trial, the District Court determined *sua sponte* that it lacked subject matter jurisdiction and dismissed the action without prejudice because the State of Tennessee ("Tennessee") was a necessary party-defendant. App., 19a-29a. Mississippi appealed to the Fifth Circuit Court of Appeals and Tennessee appeared *amicus curiae* to state the following position:

> Tennessee certainly has an interest as sovereign in the ground water within its borders. Like other natural resources, the ground water in Tennessee is held by the state in "public trust for the use of the people of the state[.]" (citation

> omitted). As sovereign, Tennessee may exercise its police power to regulate ground water so as to protect and conserve this public resource.

App., 235a. On appeal, the Fifth Circuit affirmed the District Court, holding that Tennessee was a necessary party to Mississippi's suit by reason of the State's general supervisory duties over operation of public water systems in Tennessee, including MLGW's municipal water supply program. App., 1a-18a.

It is Mississippi's primary position that its action involves only the non-state Defendants, Memphis and MLGW, and that Tennessee's core sovereign interests are not implicated; accordingly, Mississippi has contemporaneously filed a Petition for Writ of Certiorari requesting this Court's review and reversal of the Fifth Circuit's decision. Should the Court fail to grant the petition and reverse the Fifth Circuit, Mississippi's only relief is an action against Memphis, MLGW and Tennessee which will fall under this Court's original and exclusive jurisdiction under U.S. CONST. art. III, § 2, and its implementing statute, 28 U.S.C. §1251(a). App., 39a-42a. For this reason, Mississippi has named Tennessee as a Defendant in this original action, and includes an alternative prayer for appropriate legal and equitable relief against Tennessee.

Should the Court deny Mississippi's petition for a writ of certiorari or grant such petition and find Mississippi is not sovereign over its ground water, then Mississippi requests the Court to allow the filing of Mississippi's Complaint in an original action against Memphis, MLGW and Tennessee and to (i) adjudicate the parties' dispute, (ii) determine the equitable

apportionment of the ground water contained in the aquifer, (iii) award Mississippi monetary damages against Memphis and MLGW for any past diversions or takings of ground water by Memphis and MLGW that are inconsistent with the Court's apportionment; and (iv) enjoin Memphis and MLGW from future diversion and takings of ground water in a manner inconsistent with the Court's apportionment.

SUMMARY OF MISSISSIPPI'S CLAIMS

The Memphis Sand Aquifer, or Sparta Aquifer as it is known in Mississippi ("the aquifer"), is a geological formation which spans a subterranean area beneath northwest Mississippi and the western part of Tennessee. The aquifer is a deep, dense subterranean stratum or formation of sand, rock, silt and clay that is capable of storing water. This action involves the conversion by Memphis and MLGW of ground water, a vital Mississippi natural resource, that accumulated in the aquifer underlying north Mississippi over thousands of years as it slowly filtered through soil, sediment and rocks depositing a finite supply of pure water residing in the sand formation trapped or confined between two separate clay formations lying above and below the dense water-bearing sands. This ground water is the primary source of water supply for the rapidly developing area of north Mississippi, particularly Desoto County. For decades, Mississippi's ground water has been diverted and artificially siphoned and taken from Mississippi by the mechanical water well pumping operations of Memphis and MLGW.

With the growth of Memphis, it has authorized its wholly owned division, MLGW, to construct and

operate an increasingly larger and larger water well pumping operation withdrawing water from the aquifer to the point that MLGW now boasts that it operates one of the largest water well pumping operations in the world consisting of over one hundred seventy wells pumping from ten separate well fields drawing from the aquifer. In its constant expansion of its water well pumping operation MLGW has located three of its ten fields very near the Mississippi state border. From these ten fields MLGW pumps more than two hundred million gallons of ground water daily.

This aggressive extraction of groundwater by Memphis and MLGW from the aquifer has largely drained the aquifer under Memphis and created a massive cone of depression within the aquifer extending across the Tennessee state line into Mississippi. By this mechanism, Memphis and MLGW have siphoned hundreds of billions of gallons of irreplaceable pure water from Mississippi into Memphis to serve MLGW's wells. This ground water would never have moved or migrated into Tennessee under natural conditions, and cannot be replaced. Moreover, it is being taken from a rapidly growing area of Mississippi for which ground water is essential to sustain economic health and future development. This taking by Memphis and MLGW is intentional and they have taken no steps to cease or curtail their activities by which they continue to wrongfully capture, divert and convert over twenty-four million gallons of Mississippi ground water per day.

Approximately 20% of Memphis' water supply has been diverted and wrongfully taken from Mississippi over the past forty years. Mississippi seeks between $980 million and $1.23 billion in compensatory

damages (inclusive of interest) and an injunction to stop the conversion of Mississippi's valuable ground water by Memphis and MLGW. Mississippi seeks alternatively and conditionally a decree of equitable apportionment against Tennessee and an award of damages against Memphis and MLGW with an order enjoining them from diverting and taking Mississippi's water in any manner inconsistent with such apportionment.

JURISDICTION

This case, involving disputes between Mississippi and Defendants, Memphis, MLGW and Tennessee, falls squarely within the Court's exclusive and original jurisdiction under Article III, Section 2, Clause 2 of the United States Constitution and 28 U.S.C. §1251(a) & (b)(3).

This Court has concurrent (original, but not exclusive) jurisdiction with the U.S. District for the Northern District of Mississippi over Mississippi's claims against Memphis and MLGW. 28 U.S.C. §1251(b)(3). The original and exclusive jurisdiction of the Court under 28 U.S.C. §1251(a) is invoked, however, if it is determined that (a) Tennessee's sovereign rights in the ground water within its borders are implicated and that (b) this Court must equitably apportion the aquifer ground water before awarding the monetary damages and injunctive relief Mississippi seeks against Memphis and MLGW.

CONSTITUTIONAL AND STATUTORY PROVISIONS INVOLVED

The relevant constitutional and statutory provisions involved are Article III, Section 2 of the United States Constitution; 28 U.S.C. Section1251; and Mississippi Code Annotated Section 51-3-1 (2008), which are reproduced verbatim at App., 39a-42a.

STATEMENT OF THE CASE

The aquifer beneath north Mississippi is the primary source for the water supply of Desoto County, Mississippi. Memphis uses the aquifer as its sole source of municipal water supply and customer sales requirements. MLGW, a division of Memphis, is the largest three-service municipal utility in the United States, providing water, gas and electricity to Memphis and its other customers. MLGW owns and operates one of the largest artesian water systems in the world, containing over one hundred seventy-five wells in multiple well fields, some of which are located near the Mississippi state border, pumping in excess of two hundred million gallons per day. App., 56a-62a, 63a-74a, 189a, 190a-209a & 210a-214a.

MLGW's exploitation of the aquifer comes at a high price. MLGW's ground-water pumpage has created a geophysical feature known as a "cone of depression" in the aquifer that is centered in Memphis and extends into Mississippi, resulting in Memphis' diversion and taking of ground water that belongs exclusively to the State. *See* App., 108a-117a.

Hydrogeological Characteristics and the Effect of MLGW Pumpage on the Aquifer

The aquifer, often called "the 500-foot sand," is a formation occurring at depths ranging from zero to six hundred feet and varying in thickness from five hundred to eight hundred ninety feet based on interpretations of geophysical logs. App., 85a, 196a-197a. Extremely high quality ground water is stored in the aquifer formation and is naturally filtered by "moving" imperceptibly through the sand. The natural path of movement of ground water in the aquifer formation in Desoto County was, prior to MLGW's pumping, east to west through pore spaces (between sand and rock against friction) at a rate of about one inch per day. *See, e.g.*, App., 106a-107a. Ground water does not flow rapidly in a torrent or turbulent state; it is not wildly free-flowing like a stream or a river. Under natural pre-pumping conditions, it would take about six thousand years for the aquifer ground water to "move" across Desoto County, a distance of only thirty-three miles. The subject ground water, therefore, has been confined and stored beneath Mississippi for several millennia. But for MLGW's pumping, and its creation and expansion of the cone of depression, the ground water taken by Memphis and MLGW would still be contained within the territorial boundaries of Mississippi.

MLGW's pumping operations have diverted the aquifer's ground water movement from its natural east to west direction to a northward accelerated flow path toward the steepest part of the cone which underlies Memphis. *See, e.g.*, 112a-117a. As a result, MLGW's pumpage has been and is now capturing aquifer ground water beneath Mississippi. Due to demand and growth

of MLGW's system, the aquifer has been pumped and drawn down at a higher rate than it is being recharged or replenished, causing water levels to decline significantly. *See generally* App., 63a-104a.

The Cone of Depression and Its Undeniable Adverse Impact Upon Mississippi's Ground Water Resources

MLGW's pumpage and withdrawal of aquifer ground water disturbed its steady-state condition and created a dynamic flow condition, thus altering the aquifer ground-water system. These circumstances created the cone of depression under Memphis that expands deeply into Mississippi. App., 56a-62a.

Memphis and MLGW have never disputed either the existence of the huge cone caused by their pumping or its past and continuing effects on Mississippi's ground water resources. The cone results from cumulative ground water pumping from multiple wells in numerous well fields operated by MLGW for Memphis' municipal supply and sales. *See, e.g.*, App., 116a-117a.

Memphis and MLGW have been diverting and capturing aquifer ground water from Mississippi on a continual basis for decades. For the period 1965 to 2006, the range of diversions was from 13.64 million gallons per day to 28.33 million gallons per day. This equates to 15% to 22% of MLGW's ground-water supply provided by water diverted from Mississippi. Over 363 billion gallons of Mississippi's ground water have been permanently diverted from Mississippi into Memphis during the period 1965 through 2006. These diversions are ongoing; the present level of diversions of some 24

million gallons per day are expected to continue to 2017. App., 96a-104a.

Absent total cessation of MLGW's pumpage, Memphis' conversion of Mississippi's ground water will continue for the foreseeable future life of the aquifer. Because of the alteration of the ground-water system, even if MLGW were to completely cease pumping from its well fields, the ground water already diverted by Memphis will not return to Mississippi. MLGW's cessation of pumping will simply mitigate additional future diversions. App., 60a.

Once Mississippi's ground water becomes captured and encompassed within Memphis' hydrologic ground-water inventory, there is a continuous, ongoing process in which water that reaches MLGW's wells or well fields is constantly being replaced by water being continually diverted from Mississippi. App., 61a. The quantities of Mississippi's ground water diverted and taken by Memphis and MLGW are permanently lost by Mississippi. Ground water belonging to Mississippi -- now irretrievably part of Memphis' hydrologic inventory -- has been and will continue to be pumped by MLGW's wells for Memphis' supply and sales to MLGW's customers. This process will continue indefinitely into the future as long as MLGW's municipal well pumping maintains or expands the cone of depression and continues to displace and permanently capture Mississippi's water to supply MLGW's well fields. *Id. See also* 63a-104a.

Public Reports and Defendants' Awareness of the Transboundary Ground Water Diversion Problem

Since at least 1965, independent federal and state ground water scientists and experts have recorded and reported huge diversions of ground water from north Mississippi into the Memphis area. App., 224a-226a. Many, if not most, of the water supply papers and water resources investigation reports concerning the aquifer were researched, funded and prepared with cooperation of Memphis and MLGW. These scientific publications have, over decades, uniformly confirmed that MLGW's pumping has altered the ground water budget or inventory of the aquifer resulting in a permanent change in the natural flow path and rate of movement of water within the confined aquifer system. App., 49a, 54a-55a, 72a-73a, 83a-93a & 224a-226a. The cause and existence of the cone of depression and its impact upon ground water normally contained and residing exclusively within Mississippi are undisputed.

For example, in the mid-1990's, representatives of the Mississippi Department of Environmental Quantity ("MDEQ") contacted officials at MLGW to arrange for a joint, cooperative study of the ground-water diversion problem. App, 54a-55a. MDEQ representatives advised MLGW that Memphis was the largest withdrawer of ground water within Mississippi. Mississippi wanted to study the issues in order to find a solution to the problem, but Memphis and MLGW declined to cooperate. *Id.*

In the late 1990's, the Memphis news media reported that Memphis was the largest user of Mississippi's ground water, and reconfirmed the

findings of federal ground-water scientists that, in west Tennessee and north Mississippi, the natural flow of water in the aquifer would be to the west and southwest, but that the heavy pumping of municipal wells in Memphis had diverted that flow, creating a "cone of depression" that pulled water from the south, northward into Memphis' pumping centers, with over 20% of Memphis' supply coming from Mississippi. App., 189a.

At about the same time, the Tennessee Department of Environment and Conservation ("TDEC") commissioned a legal and water management and policy study of MLGW's pumpage and the effect of the tremendous cone on north Mississippi. In a report published in 2000, the potential liability of Memphis and MLGW to Mississippi for monetary damages and other relief was evaluated. App., 190a-209a. This study was presented to officials of Memphis and MLGW at the highest levels. Still, no action was taken to mitigate the conversion of ground water from Mississippi.

In 2002, Tennessee's Comptroller's Office presented a special report to the Tennessee legislature exposing the serious ground water diversion issues caused by MLGW's pumping. App., 210a-215a. As of the filing of Mississippi's motion for leave to file its Complaint, no meaningful action has been taken to resolve the worsening problems.

In view of the continuing transboundary diversions of Mississippi's valuable ground water and the lack of any interest on the part of Defendants in solving the serious dilemma, Mississippi has been prompted to

initiate proceedings in this Court against Memphis and MLGW and provisionally against Tennessee.

ARGUMENT

I. THIS COURT HAS ORIGINAL AND EXCLUSIVE JURISDICTION OVER MISSISSIPPI'S CLAIMS

Mississippi's action is premised, in part, on the State's assertion of ownership of all water resources within its borders, including the subject ground water, as one of the fundamental, self-evident attributes of statehood. State water policy, statutory enactments and judicial declarations have consistently reaffirmed, beyond question, the State's duty, police power and authority to protect the State's water resources and to control the reasonable and beneficial use of state-owned water resources by Mississippi citizens. App., 49a-55a. *See also* App., 216a-223a.

The Public Trust Doctrine and State "Ownership" of Ground Water Resources

Each State, upon entry into the Union, became vested with ownership, control and dominion over the waters within its territorial boundaries. *Phillips Petroleum Co. v. Mississippi,* 484 U.S. 469, 479 (1988); *Oregon ex rel. State Land Board v. Corvallis Sand & Gravel Co.*, 429 U.S. 363, 370-78 (1977); *Illinois Cent. R.R. Co. v. Illinois*, 146 U.S. 387, 452 (1892); *Pollard v. Hagan*, 44 U.S. 212, 222-23 (1845); *Martin v. Waddell's Lessee*, 41 U.S. 367, 410 (1842). *See also Montana v. United States,* 450 U.S. 544, 551-52 (1981); *Idaho v. Coeur d'Alene Tribe of Idaho*, 521 U.S. 261, 286-87 (1997).

Relying on this inalienable sovereignty established by the public trust, the Mississippi Supreme Court in 1986 declared the State's ownership and plenary authority over its water resources, including subterranean resources, in *Cinque Bambini Partnership v. State of Mississippi,* 491 So.2d 508, 511-14, 516-17 & 519-20 (Miss. 1986), affirmed by this Court in *Phillips Petroleum Co. v. Mississippi, supra.* Ever since the federal sovereign ceded title to Mississippi, state law has controlled ownership and allocation of the use of Mississippi's natural resources. *Oregon*, 429 U.S. at 378-82; *Cinque Bambini*, 491 So.2d at 513, 516-19. It is, thus, the State's prerogative to control and preserve state-owned resources. *Id.* at 513, 517.

Mississippi Has Owned the Ground Water Within Its Boundaries Since Statehood

The ground water at issue has been owned by Mississippi for almost two hundred years, since 1817. For over one hundred sixty years, an unbroken line of this Court's decisions beginning with *Martin v. Waddell's Lessee* (1842) has consistently traced state ownership of water and other natural resources to the American Revolution.[1]

---

[1] Each state's right and responsibility to control the water resources within its boundaries arises from the American colonies' inheritance of England's common law under which the sovereign or King owned all of the waters, forests, game, minerals and profits upon or under the land. *See Phillips Petroleum,* 484 U.S. at 479; *Oregon*, 429 U.S. at 378; *Illinois Centr.*, 146 U.S. at 452; *Pollard*, 44 U.S. at 222-23; *Waddell's Lessee,* 41 U.S. at 410. When the original thirteen colonies joined in rejecting English royal claims by the Declaration of Independence, each colony asserted

In Mississippi, the *Cinque Bambini* Court recognized that once Mississippi had been admitted to the Union and the public trust had been created and funded, the role of the equal footing policy ended and the title to and plenary authority over the lands and resources conveyed in trust became vested in the State. 491 So.2d at 512-13. *Cinque Bambini* confirmed Mississippi's ownership of subsurface resources such as ground water, *see id.* at 516-17, and the decree was upheld by this Court in *Phillips Petroleum,* 484 U.S. at 476.

Mississippi's Ownership of Its Ground Water Resources Is a Self-Evident Attribute of Statehood and Sovereignty

This Court's decisions in the early twentieth century established that each state, including Mississippi, owns the surface water and ground water resources within the geographical confines of its boundaries as a function of statehood and each state's sovereignty. *Kansas v. Colorado*, 206 U.S. 46, 94 (1907). Mississippi's case law predating *Cinque Bambini* confirmed the State's sovereign imperatives regarding ownership and control of water resources. *State Game & Fish Comm'n v. Louis Fritz Co.*, 187

---

the same governmental ownership or control over the waters and other natural resources within their boundaries as previously exercised by the sovereign. As new states entered the Union, each entered on "equal footing" with those of the original thirteen colonies; that is, each new state was presumed to be endowed with the same governmental rights and privileges, including sovereignty with respect to all natural resources within the particular territory, as the original thirteen. *Pollard,* 44 U.S. at 222-23.

Miss. 539, 193 So. 9 (1940); *State ex rel. Rice v. Stewart*, 184 Miss. 202, 184 So. 44 (1938). *See also* App., 217a.

In 1985, the Mississippi legislature codified the public trust doctrine[2], acknowledging the State's ownership of all ground water resources within Mississippi when it enacted the "Omnibus Water Rights Act" declaring:

> ***All water, whether occurring on the surface of the ground or underneath the surface of the ground, is hereby declared to be among the basic resources of this state and therefore belong to the people of this state***, and is subject to regulation in accordance with the provisions of this chapter. ***The control and development and use of water for all beneficial purposes shall be in the state, which, in the exercise of its police powers, shall take such measures to effectively and efficiently manage, protect and utilize the water resources of Mississippi.***

MISS. CODE ANN. §51-3-1 (1985 & Supp. 2008) (emphasis, in bold italics, added). Under Mississippi's Act, "[b]oth surface water and ground water are regarded as property of the State of Mississippi."

---

[2] Mississippi's sovereign powers relative to surface and ground water resources under the public trust had been confirmed by State legislative enactments dating back to 1956. App., 49a-55a. *See also* Mississippi's 1976 Ground Water Capacity Use Act, MISS. CODE ANN. §51-4-1 (1976) (declaring ground water to be among the State's basic resources subject to state control and development for the benefit of the people); MISS. CODE ANN. §5956-01 (1956) (the surface water apportionment act).

Richard J. McLaughlin, "Mississippi" in 6 *Water and Water Rights*, 712 (Robert E. Beck, Ed., 1991 ed., repl. vol. 2005).

Mississippi's Act has been part of a trend in a majority of eastern states to adopt modern regulated riparian water rights regimes. App., 221a-222a. Nationally, there has occurred a conceptual confluence of eastern (riparian) and western (prior appropriation) water law as these once very different legal regimes now converge and begin to focus on state ownership and control of threatened and dwindling water resources both east and west of the Mississippi River. Today, state ownership of water resources is universally accepted as a basic sovereign right created and sustained by the public trust, and this right is declared and enforced in the decisional law, constitutional provisions and statutory enactments of most, if not all, of the states. App. 216a-226a.

In Mississippi's appeal of the District Court's dismissal to the Fifth Circuit, Tennessee appeared *amicus curiae* arguing that, if its sovereign interests in the ground water within its borders are affected by Mississippi's claims, then it should be made a party to any equitable apportionment decreed by this Court. *See* App., 227a-242a. Essentially agreeing with Mississippi's positions regarding the states' ownership and control of ground water resources within their separate sovereign borders, Tennessee asserted that it held the ground water resources within the borders of Tennessee in public trust for the use of the people of the State, and that under its police power, it had the duty to regulate and control Tennessee's public ground water resources. App., 235a.

Based on these fundamental principles followed in all states and Tennessee's acknowledgment of its own sovereign powers in relation to ground waters within its borders, if this Court determines that Mississippi's action is one "between two states," then this Court has original exclusive jurisdiction over the parties and their dispute. 28 U.S.C. §1251(a). Of course, the Court also has original but not exclusive jurisdiction over the claims of Mississippi against non-state Defendants, Memphis and MLGW, under 28 U.S.C. §1251(b)(3).

II. THE JURISDICTION OF THIS COURT TO AWARD DAMAGES, INJUNCTIVE RELIEF OR, ALTERNATIVELY, EQUITABLE APPORTIONMENT

Mississippi's expert economists have conducted detailed analyses, computing the State's monetary damages (inclusive of prejudgment interest through 2007) to be in a range of $980 million to $1.232 billion for past diversions and wrongful takings of Mississippi's ground water from 1965-2006. App., 118a-188a. The damages sought by Mississippi have been awarded by the Court in other original actions. *Kansas v. Colorado*, 533 U.S. 1, 6, 8-10 (2001); *Virginia v. West Virginia*, 206 U.S. 290 (1907).

The *Kansas* Court recognized that a state may recover monetary damages from another state as a proper pursuit of the general public interest. 533 U.S. at 7-8. The Court determined that it is the state's prerogative to deposit proceeds from any judgment in the general coffers of the state or to use them for the benefit of those who are hurt. *Id.* at 9. The majority Court in *Kansas v. Colorado* also confirmed that prejudgment interest may be recovered in a water

resources diversion case. *Id.* at 9-11 & n.2. The fact that Memphis and MLGW are non-states from which Mississippi requests damages and injunctive relief does not alter this Court's powers to award such relief. It is well settled that, provided at least one state is on each side of the controversy, the presence of non-state parties, even indispensable parties, does not affect the exclusive original jurisdiction of the Supreme Court. *See, e.g., Arizona v. California*, 373 U.S. 546, 564 (1963); *California v. Arizona*, 440 U.S. 59, 61 (1979); *see also Maryland v. Louisiana,* 451 U.S. 725, 735-44 (1981); *Louisiana v. Mississippi*, 516 U.S. 222 (1995) (settling a boundary dispute between Louisiana and Mississippi and denying Louisiana's title claim against a private defendant).

This Court's precedent dating back over 100 years confirms the propriety of damages awards in actions brought by a state. *See Virginia v. West Virginia*, *supra*. In *Virginia*, the Court allowed an original action by Virginia for an accounting and monetary award against West Virginia for its share of over $30 million in public debt. Noting its prior decisions in controversies arising from pecuniary demands, the Court recognized that its "jurisdiction was exercised in those cases just as in those for the prevention of the flow of polluted water from one State along the borders of another State, or of the diminution of the natural flow of rivers by the State in which they have their sources through and across another State or States, or of the discharge of noxious gases from works in one State over the territory of another." 206 U.S. at 319.

Additionally, the injunctive relief sought by Mississippi has been awarded by this Court in original actions involving a state versus non-state parties. For

example, in *Wisconsin v. Illinois & Sanitary Dist. of Chicago,* 278 U.S. 367 (1929), this Court, in an original action between Wisconsin and Illinois to enjoin diversion of water from Lake Michigan into another watershed through a sanitary canal, required the non-state party, the Chicago Sanitary District, to provide sufficient funding and to construct and operate "with all reasonable expedition" adequate plants for sewage disposition by means other than by lake diversions. 278 U.S. at 420-21.

This Court's original and exclusive jurisdiction over Mississippi's alternative or provisional claims against Tennessee for equitable apportionment is well established. That this Court has most frequently exercised its §1251(a) jurisdiction over suits between states concerning the manner and use of waters of interstate lakes and rivers (albeit not ground water in subterranean geological sand formations) is beyond peradventure. Robert L. Stern, et al., *Supreme Court Practice* 550-51 (8th ed. 2002), *citing Arizona v. California,* 530 U.S. 392 (2000); *Colorado v. New Mexico,* 467 U.S. 310 (1984); *Ohio v. Kentucky,* 410 U.S. 641 (1973); *Vermont v. New York,* 406 U.S. 186 (1972); *Wisconsin v. Illinois,* 278 U.S. 367, 409 (1929), 388 U.S. 426 (1967).

Accordingly, Mississippi respectfully asserts that this Court has jurisdiction over this original action involving the claims as stated in the Complaint submitted for the Court's review contemporaneously with this Brief in Support of Mississippi's Motion for Leave to File Bill of Complaint in Original Action.

CONCLUSION

For the foregoing reasons, this Court should grant Mississippi's Motion for Leave to File Bill of Complaint in Original Action. Mississippi additionally requests such other or further relief to which it may be entitled.

Respectfully submitted,

Alan B. Cameron
Counsel of Record
Larry D. Moffett
Daniel Coker Horton & Bell, P.A.
Oxford Square North
265 North Lamar Blvd., Suite R
Post Office Box 1396
Oxford, MS 38655
(662) 232-8979

C. Michael Ellingburg
Daniel Coker Horton & Bell, P.A.
4400 Old Canton Road, Suite 400
Post Office Box 1084
Jackson, MS 39215-1084

John W. (Don) Barrett
David M. McMullan, Jr.
Barrett Law Office, P.A.
404 Court Square North
Post Office Box 987
Lexington, MS 39095
(662) 834-2376

Geoffrey C. Morgan
George W. Neville
Mississippi Attorney
General's Office
Walter Sillers State Office
Building
Suite 1200
550 High Street
Jackson, MS 39201
(601) 359-3680

George B. Ready
George B. Ready
Attorneys
Post Office Box 127
Hernando, MS 38632
(662) 429-7088

APPENDIX

APPENDIX A

IN THE UNITED STATES COURT OF APPEALS FOR THE FIFTH CIRCUIT

No. 08-60152

[Filed June 5, 2009]

JIM HOOD, Attorney General, ex rel; STATE OF MISSISSIPPI, Acting for Itself and Parens Patriae for and on behalf of the People of the State of Mississippi

Plaintiffs-Appellants

v.

THE CITY OF MEMPHIS, TENNESSEE; MEMPHIS LIGHT GAS & WATER DIVISION

Defendants-Appellees

Appeal from the United States District Court for the Northern District of Mississippi

Before HIGGINBOTHAM, BENAVIDES, and STEWART, Circuit Judges.

CARL E. STEWART, Circuit Judge:

In this lawsuit, the state of Mississippi seeks damages from the City of Memphis and Memphis Light, Gas and Water ("MLGW") (collectively, "Memphis"), for the alleged conversion of groundwater in the Memphis Sands Aquifer (the "Aquifer"). The district court dismissed Mississippi's lawsuit without prejudice, holding that Tennessee is an indispensable party to the suit and that the court was without power to join Tennessee. We AFFIRM.

I. BACKGROUND

The Aquifer is located beneath portions of Tennessee, Mississippi, and Arkansas. There is no interstate compact governing use of the Aquifer's water, and thus no specific volumes of groundwater from the Aquifer have been apportioned to Mississippi, Tennessee, or Arkansas. The Aquifer is the primary water source for both DeSoto County, Mississippi, and the city of Memphis, Tennessee, which lies just across the state line from DeSoto County. Mississippi seeks past and future damages, as well as equitable relief, related to Memphis's allegedly wrongful appropriation of groundwater from the Aquifer.[1] Mississippi alleges that part of the groundwater that Memphis pumps from the Aquifer is Mississippi's sovereign property and that the state must therefore be compensated.

MLGW, a division of the City of Memphis, owns and operates one of the largest artesian water systems

---

[1] Although there was some dispute between the parties below as to the basis of jurisdiction, federal question jurisdiction is present both because 28 U.S.C. § 1331(a) includes suits brought by a state and because federal common law will apply to the dispute. *See Illinois v. City of Milwaukee*, 406 U.S. 91, 99 (1972).

in the world. It is responsible for providing gas, electricity, and water to its residential, business, governmental, and other customers, who are primarily citizens of Memphis. Although three of its groundwater well fields are located near the Tennessee border, all of MLGW's wells are located within Tennessee, and Memphis and Tennessee contend that this municipal water program operates under the direction and control of Tennessee law.[2]

Mississippi asserts that MLGW's groundwater pumping has created an underground "cone of depression" centered under Memphis and extending into Mississippi. Mississippi states that this cone of depression causes groundwater that would otherwise lie beneath Mississippi to flow across the border and into the cone under Tennessee, and thus become available to be pumped by Memphis. Mississippi argues that due to the growth of Memphis's water system the Aquifer is being drawn down at a higher rate than it is being replenished, thus causing water levels to drop.

Mississippi filed its first complaint against Memphis in February 2005. Memphis filed a motion to dismiss on several bases, including that the state of Tennessee was an indispensable party pursuant to

---

[2] *See, e.g.*, TENN. CODE ANN. § 68-221-707 (Tennessee Department of Environment and Conservation exercises supervision over operation of public water systems, including features of operation that affect quantity of water supplied). Mississippi contends that Memphis's groundwater pumping is not controlled by Tennessee law, but cites no legal authority for that conclusion, and neither does it address the provisions of Tennessee law cited in Memphis's brief.

Federal Rule of Civil Procedure 19. The motion to dismiss was denied in August 2005. Memphis then moved to "amend" the district court's order or to certify an interlocutory appeal. Construing the motion to amend as a motion for rehearing, the district court denied both motions in September 2005. Memphis filed an answer and subsequent amended answer. Mississippi filed an amended complaint in October 2006, eliminating certain claims and clarifying its request for an award of monetary damages for Memphis's alleged misappropriation of Mississippi's groundwater.

In June 2007, Memphis moved for judgment on the pleadings, again arguing that Tennessee was an indispensable party to the suit. Memphis also moved for partial summary judgment on several of Mississippi's claims. In September 2007, the court denied the motions.

In late January 2008, shortly before the bench trial was to start, the district court announced that it had decided *sua sponte* to revisit the issue of Tennessee's possible status as an indispensable party and thus the court's subject-matter jurisdiction. After briefing from the parties and oral argument, the district court dismissed the suit for failure to include Tennessee, an indispensable party.[3] Mississippi appeals.

---

[3] In its opinion dismissing this suit, the district court directed that the Arkansas Attorney General should be put on notice of the pendency of this action and any future action filed in the U.S. Supreme Court, although the court refrained from determining whether Arkansas is also an indispensable party.

II. DISCUSSION

A. Standard of Review

We review the district court's decision to dismiss for failure to join an indispensable party for an abuse of discretion. *HS Res., Inc. v. Wingate*, 327 F.3d 432, 438-39 (5th Cir. 2003). Determining whether an entity is an indispensable party is a highly-practical, fact-based endeavor, and "[Federal Rule of Civil Procedure] 19's emphasis on a careful examination of the facts means that a district court will ordinarily be in a better position to make a Rule 19 decision than a circuit court would be." *Pulitzer-Polster v. Pulitzer*, 784 F.2d 1305, 1309 (5th Cir. 2006). However, "[a] court abuses its discretion when its ruling is based on an erroneous view of the law." *Chaves v. M/V Medina Star*, 47 F.3d 153, 156 (5th Cir. 1995).

Determining whether to dismiss a case for failure to join an indispensable party requires a two-step inquiry. First the district court must determine whether the party should be added under the requirements of Rule 19(a). Rule 19(a)(1) requires that a person subject to process and whose joinder will not deprive the court of subject-matter jurisdiction be joined if:

> (A) in that person's absence, the court cannot accord complete relief among existing parties; or (B) that person claims an interest relating to the subject of the action and is so situated that disposing of the action in the person's absence may: (i) as a practical matter impair or impede the person's ability to protect the interest; or (ii) leave an existing party subject to a

> substantial risk of incurring double, multiple, or otherwise inconsistent obligations because of the interest.

FED. R. CIV. P. 19(a)(1). While the party advocating joinder has the initial burden of demonstrating that a missing party is necessary, after "an initial appraisal of the facts indicates that a possibly necessary party is absent, the burden of disputing this initial appraisal falls on the party who opposes joinder." *Pulitzer-Polster*, 784 F.2d at 1309.

If the necessary party cannot be joined without destroying subject-matter jurisdiction, the court must then determine whether that person is "indispensable," that is, whether litigation can be properly pursued without the absent party. *HS Res.*, 327 F.3d at 439. The factors that the district court is to consider in making this determination are laid out in Rule 19(b):

> (1) the extent to which a judgment rendered in the person's absence might prejudice that person or the existing parties; (2) the extent to which any prejudice could be lessened or avoided by; (A) protective provisions in the judgment; (B) shaping the relief; or (C) other measures; (3) whether a judgment rendered in the person's absence would be adequate; and (4) whether the plaintiff would have an adequate remedy if the action were dismissed for nonjoinder.

FED. R. CIV. P. 19(b).

Mississippi contends that the district court misapplied Rule 19 in holding that Tennessee is a necessary and indispensable party because its suit does not implicate any sovereign interest of Tennessee. Mississippi argues that its suit does not require an equitable apportionment of the Aquifer because the state owns the groundwater resources of the state as a self-evident attribute of statehood, and thus there is no interstate water to be equitably apportioned. Mississippi further argues that it is not seeking relief for damages caused by the direct actions of Tennessee, and therefore the suit is not an action between states invoking the original jurisdiction of the Supreme Court.

Memphis responds that the district court correctly determined that the nature of Mississippi's claims and asserted ownership of a water resource that it shares with Tennessee makes Tennessee an indispensable party to suit. Memphis argues that because Tennessee's sovereign ownership rights in the Aquifer water, the same which Mississippi seeks to protect, are implicated, the case cannot be properly resolved without Tennessee's participation. Memphis points to a century of Supreme Court case law addressing the equitable apportionment of interstate waters among states to argue that the district court correctly held that joining Tennessee would create a suit between states that must be filed in the Supreme Court.[4]

---

[4] Tennessee, participating in this appeal as *amicus curiae*, asserts that it has a sovereign interest in its share of Aquifer water as great as that asserted by Mississippi, and it therefore is a necessary and indispensable party to any suit over Memphis's withdrawals from the Aquifer.

B. Tennessee is a Necessary Party to this Water Ownership Dispute

The district court held that Tennessee was a necessary party under Rule 19(a)(1) because in its absence complete relief could not be accorded between Memphis and Mississippi. The court explained that it could not determine whether Memphis had misappropriated water from the Aquifer without determining *what portion* of the Aquifer belongs to Mississippi and Tennessee respectively, and thus an equitable apportionment of the Aquifer between the states was required. In so holding, the district court rejected Mississippi's argument, renewed on appeal, that only Mississippi's water is at issue. Mississippi's fundamental argument as to why Tennessee's presence in the lawsuit is unnecessary is that the Aquifer's water is not an interstate resource subject to equitable apportionment, and therefore Tennessee's sovereign interests are not implicated by the suit.

We find that the district court made no error of law as to the necessity of equitably apportioning the Aquifer. The Aquifer is an interstate water source, and the amount of water to which each state is entitled from a disputed interstate water source must be allocated before one state may sue an entity for invading its share. *See Hinterlander v. La Plata River & Cherry Creek Ditch Co.*, 304 U.S. 92, 104-05 (1938). Allocation of an interstate water source is accomplished through a compact approved by Congress or an equitable apportionment. *Id.*

"Equitable apportionment is the doctrine of federal common law that governs disputes between states concerning their rights to use the water of an

interstate stream." *Colorado v. New Mexico*, 459 U.S. 176, 183 (1982). The Supreme Court has described the applicability of this doctrine in broad terms:

> [W]henever . . . the action of one state reaches, through the agency of natural laws, into the territory of another state, the question of the extent and the limitations of the rights of the two states becomes a matter of justiciable dispute between them, and this court is called upon to settle that dispute in such a way as will recognize the equal rights of both and at the same time establish justice between them.

Kansas v. Colorado, 206 U.S. 46, 97-98 (1907). Determining Mississippi and Tennessee's relative rights to the Aquifer brings this case squarely within the original development and application of the equitable apportionment doctrine. The fact that this particular water source is located underground, as opposed to resting above ground as a lake, is of no analytical significance. The Aquifer flows, if slowly, under several states, and it is indistinguishable from a lake bordered by multiple states or from a river bordering several states depending upon it for water. *See, e.g., Nebraska v. Wyoming*, 515 U.S. 1 (1995) (allocation of North Platte River); *Wisconsin v. Illinois*, 449 U.S. 48, 50 (1980) (amending order allocating usage of portions of Lake Michigan).[5]

---

[5] A handful of Supreme Court cases mention aquifers in the context of interstate water disputes. *See Texas v. New Mexico*, 462 U.S. 554, 556-57, n.1, 2 (1983) (discussing role of New Mexico aquifers feeding the Pecos River, subject of litigation, and possible detrimental effects of pumping); *Wisconsin*, 449 U.S. at 50 (court order amending prior decree with requirements including "to the

Mississippi argues that it owns a fixed portion of the Aquifer because it controls the resources within its state boundaries, citing to Mississippi and federal law demonstrating the state's sovereign rights over the soil, forest, minerals, etc. Despite Mississippi's contentions, it is clear that the Aquifer is not a fixed resource like a mineral seam, but instead migrates across state boundaries. The Supreme Court has consistently rejected the argument advanced by different states, and advanced by Mississippi in this lawsuit, that state boundaries determine the amount of water to which each state is entitled from an interstate water source.[6] *See, e.g.*, *Hinterlander*, 304 U.S. at 102 (Colorado's contention that it "rightfully may divert and use . . . the waters flowing within her boundaries in this interstate stream . . . cannot be maintained. The river throughout its course in both states is but a single stream, wherein each state has an interest which should be respected by the other,"

---

extent practicable allocations to new users of Lake Michigan water shall be made with the goal of reducing withdrawals from the Cambrian-Ordovician aquifer"). While these opinions do not address aquifer allocation directly, the fact that the aquifers were not treated differently from any other part of the interstate water supply subject to litigation supports the conclusion that the Aquifer at issue must be apportioned.

[6] Notably, the equitable apportionment doctrine has been used to address other migratory interstate resources, including the apportionment of fish that make an interstate migration. *See Idaho v. Oregon*, 462 U.S. 1017, 1024 (1983) ("Although that doctrine has its roots in water rights litigation, the natural resource of [migratory salmon] is sufficiently similar to make equitable apportionment an appropriate mechanism for resolving allocative disputes.").

quoting *Wyoming v. Colorado*, 259 U.S. 419, 466 (1922)).

The Aquifer must be allocated like other interstate water resources in which different states have competing sovereign interests, and whose allotment is subject to interstate compact or equitable allocation. Therefore, we find no error in the district court's conclusion that Tennessee's presence in the lawsuit was necessary to accord complete relief to Mississippi and Memphis. *See Pulitzer-Polster*, 784 F.2d at 1309.

C. Tennessee's Joinder Would Destroy Subject-Matter Jurisdiction

After finding Tennessee to be a necessary party, the district court held that it was without power to join the state because original and exclusive jurisdiction over a suit between Mississippi and Tennessee would reside in the United States Supreme Court. *See* 28 U.S.C. § 1251(a) ("The Supreme Court shall have original and exclusive jurisdiction of all controversies between two or more States."). Mississippi argues that even if Tennessee's presence in the suit is necessary, it does not invoke the Supreme Court's original jurisdiction, and the district court could therefore retain jurisdiction over the case. We disagree.

Mississippi argues that the district court has subject-matter jurisdiction because this suit is only against Memphis, not Tennessee, and would at most be subject to the Supreme Court's original but non-exclusive jurisdiction. *See* 28 U.S.C. § 1251(b)(3) ("The Supreme Court shall have original but not exclusive jurisdiction of . . . All actions or proceedings by a State against the citizens of another State."). The

Supreme Court has in the past stated a preference that such suits be brought in the district court in the first instance. *See United States v. Nevada*, 412 U.S. 534, 538 (1973). Mississippi's argument that its suit is not against Tennessee hangs on the assertion that only Memphis's actions, and not Tennessee's, are at issue. *See Milwaukee*, 406 U.S. at 97 (holding that where Illinois sued Milwaukee for polluting Lake Michigan, not mandatory to sue Wisconsin as well). However, that contention ignores that, in contrast to *Milwaukee*, this suit requires an allocation of water rights between states: Memphis's actions are not wrongful unless there is a defined allocation of water that it is allowed to pump. Tennessee is a necessary party under Rule 19(a) on that basis, and the suit is thus one between two states.

Mississippi correctly argues that a suit involving interstate water does not *automatically* invoke the jurisdiction of the Supreme Court and strip the district court of jurisdiction. However, the cases to which Mississippi analogizes are distinguishable. Four cases upon which Mississippi relies most heavily are suits against the U.S. Army Corps of Engineers ("Corps of Engineers"), not against other states, and therefore plainly not within the scope of 28 U.S.C. § 1251(a). *See Alabama v. U.S. Army Corps of Eng's*, 424 F.3d 1117, 1130 (11th Cir. 2005) ("*Alabama II*") (recognizing that Alabama's suit against the Corps of Engineers was not a dispute between states, despite intervention of other states as parties, because the litigation was over how the Corps of Engineers should fulfill its obligations under federal law); *Georgia v. U.S. Army Corps of Eng's*, 302 F.3d 1242, 1254-55 (11th Cir. 2002) (same); *Alabama v. U.S. Army Corps of Eng's*, 382 F. Supp. 2d 1301, 1309-12 (N.D. Ala. 2005) ("*Alabama I*") (same);

also South Dakota v. Ubbelohde, 330 F.3d 1014, 1025-26 (8th Cir. 2003) (same).

Mississippi also relies heavily on *Milwaukee v. Illinois*, the case that the district court identified as the basis for its earlier rulings denying Memphis's arguments that Tennessee is an indispensable party. 406 U.S. 91 (1972). *Milwaukee* is distinguishable. *Milwaukee* involved a federal common law nuisance action to stop alleged pollution of Lake Michigan by the city of Milwaukee's sewage disposal practices. The Supreme Court denied Illinois's motion for leave to file a bill of complaint against Wisconsin, holding that the action did not trigger the Supreme Court's exclusive jurisdiction. The Court found that, under appropriate pleadings, Wisconsin could be joined as a defendant, but that it was not a mandatory defendant on the facts of the case. *Id.* at 97. The Court concluded that the case fell under 28 U.S.C. § 1251(b)(3), giving the Supreme Court original but not exclusive jurisdiction over certain actions, and therefore Illinois could and should file suit in the appropriate federal district court. *Id.* at 108.

Mississippi argues that *Milwaukee* is a more analogous case than the water-allocation cases because Mississippi, like Illinois, merely seeks to enjoin the actions of the city of Memphis and does not have any claim against Tennessee as a state. Mississippi's argument fails, however, because of the crucial factual difference between the two cases: *Milwaukee* involved stopping the pollution of what was agreed to be an interstate water body, while Mississippi claims sole ownership of a portion of the interstate water at issue. Mississippi's suit necessarily asserts control over a portion of the interstate resource Memphis currently

utilizes pursuant to Tennessee law. *See, e.g.*, TENN. CODE ANN. § 68-221-707(a)-(b) ("The [Tennessee Department of Environment and Conservation] shall exercise general supervision over the operation and maintenance of public water systems throughout the state. . . . [including] all the features of operation and maintenance which do or may affect the quality or quantity of the water supplied."). Tennessee's water rights are clearly implicated, even if Mississippi has sued only Memphis. *Cf. Colorado v. Kansas*, 320 U.S. at 393 (noting that controversy between states over rightful shares of the Arkansas River "is not to be determined as if it were one between two private riparian proprietors or appropriators"); *Kansas v. Colorado*, 206 U.S. at 100 (noting the court must consider the effect that one state's increased share of water has on another state in order to determine amount of water each is entitled to from river).

Tennessee cannot be joined to this suit without depriving the district court of subject-matter jurisdiction because a suit between Mississippi and Tennessee for equitable apportionment of the Aquifer implicates the exclusive jurisdiction of the Supreme Court under 28 U.S.C. § 1251(a).

D. There Was No Abuse of Discretion in Dismissing the Suit

Having concluded that Tennessee is a necessary party whose joinder would deprive the district court of subject-matter jurisdiction, we turn to whether the district court abused its discretion in dismissing the suit under Rule 19(b). When assessing the Rule 19(b) factors, the relevant inquiry is "whether, in equity and good conscience, the action should proceed among the

existing parties or should be dismissed." FED. R. CIV. P. 19(b); *see Pulitzer-Polster*, 784 F.2d at 1312 ("[W]e must assess the factors set out in Rule 19(b), seeking to avoid manifest injustice while taking full cognizance of the practicalities involved.").

We find no abuse of discretion in the district court's determination that Tennessee is an indispensable party and that in equity and good conscience the suit should be dismissed. Clearly a judgment rendered in Tennessee's absence would be enormously prejudicial to Tennessee's sovereign interest in its water rights. The specter of a determination of Tennessee's water rights without the its participation in the suit is itself sufficiently prejudicial to render the state an indispensable party. *Cf. Hinterlider*, 304 U.S. at 106-07 (noting that judicial apportionment of water from an interstate stream is binding on all water claimants from each state); *New Jersey v. New York*, 283 U.S. 336, 346 (1931) ("[A river] offers a necessity of life that must be rationed among those that have power over it. . . . Both States have real and substantial interests in the River that must be reconciled as best they may."). Further, there was no error in the district court's finding that it could not fashion restrictions in the judgment so as to avoid the threat of prejudice to Tennessee's sovereign interests or that a judgment rendered without Tennessee's participation would be inadequate. *Cf. Idaho v. Oregon*, 462 U.S. 1017, 1025 (1983) ("[W]henever . . . the action of one State reaches through the agency of natural laws into the territory of another State, the question of the extent and the limitations of the rights of the two States becomes a matter of justiciable dispute between them. . . ."); *Colorado v. Kansas*, 320 U.S. at 392 ("The reason for judicial caution in

adjudicating the relative rights of states [to shares of interstate water] is that . . . they involve the interests of quasi-sovereigns, [and] present complicated and delicate questions. . . .").

Finally, Mississippi will have an adequate remedy despite this suit's dismissal. *See* 28 U.S.C. § 1251(a). In an equitable apportionment action, the Supreme Court might take one of several actions, such as concluding that the existing withdrawals of groundwater from the Aquifer in Tennessee are appropriate or limiting the total volume of Aquifer water that may be withdrawn by either party. *See Colorado v. Kansas*, 320 U.S. at 391; *New Jersey*, 283 U.S. at 346.[7]

III. CONCLUSION

For the foregoing reasons we AFFIRM the judgment of the district court.

---

[7] Of course, the parties might also negotiate an interstate compact allocating the resource going forward rather than continue litigation. *See Colorado v. Kansas*, 320 U.S. at 392 (encouraging the parties to seek a negotiated, political solution rather than requiring the Supreme Court to make a necessarily imperfect determination).

UNITED STATES COURT OF APPEALS
FOR THE FIFTH CIRCUIT

No. 08-60152
D.C. Docket No. 2:05-CV-32

[Filed June 5, 2009]

JIM HOOD, Attorney General, ex rel; STATE OF MISSISSIPPI, Acting for Itself and Parens Patriae for and on behalf of the People of the State of Mississippi	)
Plaintiffs-Appellants	)
v.	)
THE CITY OF MEMPHIS, TENNESSEE; MEMPHIS LIGHT GAS & WATER DIVISION	)
Defendants-Appellees	)

Appeal from the United States District Court
for the Northern District of Mississippi

Before HIGGINBOTHAM, BENAVIDES, and STEWART, Circuit Judges.

JUDGMENT

This cause was considered on the record on appeal and was argued by counsel.

It is ordered and adjudged that the judgment of the District Court is affirmed.

IT IS FURTHER ORDERED that plaintiffs-appellants pay to defendants-appellees the costs on appeal to be taxed by the Clerk of this Court.

ISSUED AS MANDATE: JUN 29 2009

A True Copy
Attest

Clerk, U.S. Court of Appeals, Fifth Circuit
By: /s/ _____
Deputy

New Orleans, Louisiana JUN 29 2009

APPENDIX B

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF MISSISSIPPI
DELTA DIVISION

No. 2:05CV32-D-B

[Filed February 6, 2008]

JIM HOOD, Attorney General, *ex rel.*, THE STATE OF MISSISSIPPI, acting for itself and *Parens Patriae* for and on behalf of the People of the State of Mississippi

PLAINTIFF

vs.

THE CITY OF MEMPHIS, TENNESSEE; and MEMPHIS LIGHT, GAS & WATER DIVISION

DEFENDANTS

BENCH OPINION DISMISSING ACTION WITHOUT PREJUDICE

The United States Supreme Court held, in Steel Company v. Citizens for a Better Environment, 523 U.S. 83, 101-102 (1998), that Article III generally

requires a federal court to satisfy itself of its jurisdiction over the subject matter before it considers the merits of a case and that "for a court to pronounce upon [the merits] when it has no jurisdiction to do so is for a court to act *ultra vires*." See also Villarreal v. Smith, 201 Fed. Appx. 192, 194 (5th Cir. 2006) ("A federal court has the affirmative duty to inquire into jurisdiction whenever the possibility of a lack of jurisdiction arises."); Warren v. United States, 874 F.2d 280, 281-82 (5th Cir. 1989) (holding that "federal courts are under a continuing duty to inquire into the basis of jurisdiction ..."); Giannakos v. M/V Bravo Trader, 762 F.2d 1295, 1297 (5th Cir. 1985) ("United States District Courts . . . have the responsibility to consider the question of subject matter jurisdiction *sua sponte* . . . and to dismiss any action if such jurisdiction is lacking."); Fed. R. Civ. P. 12(h)(3) ("Whenever it appears by suggestion of the parties or otherwise that the court lacks jurisdiction of the subject matter, the court shall dismiss the action.").

Discussion

The Plaintiff initiated this action seeking past and future damages as well as equitable relief related to the Defendants' alleged wrongful appropriation of groundwater from the Memphis Sands Aquifer.

Although it is the Defendants that seek a ruling that the State of Tennessee is an indispensable party to this action, "when an initial appraisal of the facts indicates that a possibly necessary party is absent, the burden of disputing this initial appraisal falls on the party who opposes joinder." Pulitzer-Polster v. Pulitzer, 784 F.2d 1305, 1309 (5th Cir. 1986). Because the court has indicated that a possibly necessary party

is absent from this action, the burden of disputing joinder falls on the Plaintiff.

Rule 19(a) of the Federal Rules of Civil Procedure provides in part that:

> A person who is subject to service of process and whose joinder will not deprive the court of jurisdiction over the subject matter of the action shall be joined as a party in the action if (1) in the person's absence complete relief cannot be accorded among those already parties, or (2) the person claims an interest relating to the subject of the action and is so situated that the disposition of the action in the person's absence may (I) as a practical matter impair or impede the person's ability to protect that interest or (ii) leave any of the persons already parties subject to a substantial risk of incurring double, multiple, or otherwise inconsistent obligations by reason of the claimed interest.

Fed. R. Civ. P. 19(a).

Rule 19(b) states that:

> If a person as described in subdivision (a)(1)-(2) hereof cannot be made a party, the court shall determine whether in equity and good conscience the action should proceed among the parties before it, or should be dismissed, the absent person being thus regarded as indispensable. The factors a court should consider in determining whether a party is indispensable include: first, to what extent a judgment rendered in the person's absence

> might be prejudicial to the person or those already parties; second, the extent to which, by protective provisions in the judgment, by the shaping of relief, or other measures, the prejudice can be lessened or avoided; third, whether a judgment rendered in the person's absence will be adequate; fourth, whether the plaintiff will have an adequate remedy if the action is dismissed for nonjoinder.

Fed. R. Civ. P. 19(b).

Under Rule 19, the court's analysis is conducted as follows:

> The court initially must determine whether the absent person's interest in the litigation is sufficient to satisfy one or more of the tests set out in the first sentence of Rule 19(a). There is no precise formula for determining whether a particular nonparty must be joined under Rule 19(a). Rather, the decision has to be made in terms of the general policies of avoiding multiple litigation, providing the parties with complete and effective relief in a single action, and protecting the absent persons from the possible prejudicial effect of deciding the case without them. If joinder under Rule 19(a) is not feasible because, e.g., it will deprive the court of subject matter jurisdiction, the court must examine the four considerations described in Rule 19(b) to determine whether the action may go forward (without the absentee) or must be dismissed, the absent person being thus regarded as indispensable.

Faloon v. Sunburst Bank, 158 F.R.D. 378, 380 (N.D. Miss. 1994).

While there are apparently no reported cases dealing with interstate subsurface water or aquifers, it is admitted by all parties and revealed in exhibits that the Memphis Sands or Sparta aquifer lies under several States including the States of Tennessee and Mississippi.

In applying the dictates of Rule 19 to the facts of this case, the court holds that the State of Tennessee is a necessary and indispensable party. First, the doctrine of equitable apportionment has historically been the means by which disputes over interstate waters are resolved. The United States Supreme Court has held that it possesses a "serious responsibility to adjudicate cases where there are actual existing controversies over how interstate streams should be apportioned among States." Arizona v. California, 373 U.S. 546, 564 (1963); *see* Texas v. New Mexico, 462 U.S. 554, 567 (1983) (The Supreme Court held that "[t]here is no doubt that this court's jurisdiction to resolve controversies between two states . . . extends to a properly framed suit to apportion the waters of an interstate stream between States through which it flows . . .").

The subject aquifer in the case *sub judice* has not been apportioned, neither by agreement of the involved States nor by the U.S. Supreme Court. However, absent apportionment, this court cannot afford relief to the Plaintiff and hold that the Defendants are pumping water that belongs to the State of Mississippi, because it has not yet been determined which portion of the aquifer's water is the property of

which State. It is simply not possible for this court to grant the relief the Plaintiff seeks without engaging in a *de facto* apportionment of the subject aquifer; such relief, however, is in the original and exclusive jurisdiction of the United States Supreme Court because such a dispute is necessarily between the State of Mississippi and the State of Tennessee. Throughout the years, the Supreme Court has adjudicated many such disputes pursuant to its original and exclusive jurisdiction, including one between the States of Mississippi and Louisiana involving the Mississippi River. See, e.g., Louisiana v. Mississippi, 516 U.S. 22 (1995); Mississippi v. Louisiana, 506 U.S. 73 (1992); Virginia v. Maryland, 540 U.S. 56 (2003); Kansas v. Colorado, 514 U.S. 673 (1995); Nebraska v. Wyoming, 515 U.S. 1 (1995); Colorado v. New Mexico, 467 U.S. 310 (1984); Arizona v. California, 373 U.S. 546 (1963); New Jersey v. New York, 345 U.S. 369 (1953); Nebraska v. Wyoming, 325 U.S. 665 (1945); Connecticut v. Massachusetts, 282 U.S. 660 (1931); Kansas v. Colorado, 206 U.S. 46 (1907). In another analogous case, the Fifth Circuit held that the United States was an indispensable party in a suit filed by a Texas municipality and other individual landowners against several defendants who claimed irrigation rights to the Rio Grande River; while the Plaintiffs in that case did join the United States as a defendant, the Fifth Circuit held that sovereign immunity prevented joinder of the United States, but because it was a necessary and indispensable party and the suit could therefore not go forward without it as a party, the suit was dismissed. Miller v. Jennings, 243 F.2d 157 (5th Cir. 1957).

While this court, in initially denying the Defendants' motion seeking relief under Rule 19, relied

upon another Supreme Court case, Illinois v. City of Milwaukee, Wisconsin, 406 U.S. 91 (1972), for the proposition that a State need not be joined in a nuisance action brought by a neighboring State against cities and local commissions in that State and involving an interstate waterway, the court finds that cases such as Louisiana v. Mississippi are more closely analogous to the case *sub judice* because the partition of an interstate body of water is a necessary condition of affording the Plaintiff relief in this case. The case *sub judice* involves a proprietary or ownership interest in subsurface water. The Illinois v. City of Milwaukee, Wisconsin case did not involve a dispute over ownership of interstate water or any other property; the Louisiana v. Mississippi case, as well as other aforecited cases, did involve disputes over such ownership issues.

Turning to Rule 19(a)'s requirements, the court finds that Rule 19(a)(1) renders the State of Tennessee a necessary party because in its absence complete relief cannot be accorded among those already parties to the action. This is true because to afford the State of Mississippi the relief sought and to hold that the Defendants have misappropriated Mississippi's water from the Memphis Sands aquifer, the court must necessarily determine which portion of the aquifer's water belongs to Mississippi, which portion belongs to Tennessee, and so on, thereby effectively apportioning the aquifer. Mississippi cannot be afforded any relief otherwise. The court also notes that, while the Plaintiff contends on the one hand that only Mississippi water is involved in this suit, it also contends that the sole basis for the court's jurisdiction is the existence of a federal question because interstate water is the subject of the suit. The Plaintiff cannot

have it both ways. The court also notes that diversity jurisdiction is not possible in this case because the Plaintiff State of Mississippi brings this suit on its own behalf and it is clear that a State is not a citizen of itself and therefore cannot sue or be sued in federal court on the basis of federal diversity jurisdiction. Moor v. County of Alameda, 411 U.S. 693 (1973).

However, joinder of the State of Tennessee as a party to this suit is not possible because this court is without jurisdiction to hear such a dispute. As noted previously, original and exclusive jurisdiction of all controversies between two or more States is vested in the United States Supreme Court. See 28 U.S.C. § 1251. Thus, the court must also examine the dictates of Rule 19(b) and determine whether, in equity and good conscience, this action should proceed among the parties before it, or should be dismissed, with the State of Tennessee being thus regarded as indispensable. The court will examine Rule 19(b)'s four considerations in turn.

First, the court must consider to what extent a judgment rendered in Tennessee's absence might be prejudicial to Tennessee or to those already parties to this action. The court holds that a judgment in this matter rendered in the absence of Tennessee will be acutely prejudicial to Tennessee's interests. As the Supreme Court has noted, no single State is permitted to impose its own policy choices on neighboring States. BMW of North Am., Inc. v. Gore, 517 U.S. 559, 572 (1996); *see* Hartford Accident & Indem. Co. v. Delta & Pine Land Co., 292 U.S. 143, 149 (1934) (holding that a State "cannot extend the effect of its laws beyond its borders so as to destroy or impair the right of citizens of [a neighboring State]."). In effect, a judgment

adverse to the Defendants in this case, prior to apportionment of the subject aquifer (which can only occur via agreement by the impacted States or by the Supreme Court), would determine the rights of the State of Tennessee and its citizens to the valuable water resources in the subject aquifer, without Tennessee having been a party to this action. Thus, the court finds that a judgment rendered in Tennessee's absence in this case would be prejudicial to Tennessee.

Second, the court is unaware of any means by which, via protective provisions in the judgment, by the shaping of relief, or other measures, the prejudice to Tennessee can be lessened or avoided. To afford any relief to the Plaintiff of necessity requires apportionment of the subject aquifer, thereby causing great prejudice to Tennessee.

Third and fourth, a judgment rendered in Tennessee's absence will not be adequate given the factors previously discussed by the court; however, the Plaintiff in this matter will certainly have an adequate remedy if this action is dismissed for nonjoinder. As noted above, original and exclusive jurisdiction over disputes of this type are vested in the United States Supreme Court, which has typically in the past assigned these disputes to a Special Master, who then makes proposed findings of fact and conclusions of law to the Supreme Court, which subsequently renders a decision in the case. This court's decision today in no way ends this dispute or renders the State of Mississippi without its day in court. While the Supreme Court has stated that "where possible, States [should] settle their controversies by mutual accommodation and agreement," if such a resolution is

not possible in this case, a well-established means exists for Mississippi to petition the Supreme Court for apportionment of the waters of the Memphis Sands aquifer in a suit that properly joins all necessary and indispensable parties, including the State of Tennessee. See, e.g., Louisiana v. Mississippi, 516 U.S. 22 (1995); Mississippi v. Louisiana, 506 U.S. 73 (1992); Kansas v. Colorado, 206 U.S. 46 (1907).

Given the foregoing, the court hereby finds that the State of Tennessee is a necessary and indispensable party to this action pursuant to Rule 19 of the Federal Rules of Civil Procedure. Because the joinder of Tennessee is not possible in this court, the court hereby determines that in equity and good conscience this action should be dismissed without prejudice, with the State of Tennessee being regarded by the court as indispensable.

While the court makes no formal determination in its opinion today regarding the necessity or indispensability of the State of Arkansas to this action, the court is of the opinion that Arkansas (via its current Attorney General) should be put on notice of the pendency of this action and any future action filed in the Supreme Court.

This opinion is appealable to the United States Court of Appeals for the Fifth Circuit. The court directs that all submissions to this court be included in and made a part of the record in this case.

A separate order in accordance with this bench opinion shall issue this day.

This the 4th day of February 2008.

/s/ Glen H. Davidson
Senior Judge

APPENDIX C

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT
OF MISSISSIPPI
DELTA DIVISION

No. 2:05CV32-D-B

[Filed September 25, 2007]

JIM HOOD, Attorney General, *ex rel.*, THE STATE OF MISSISSIPPI, acting for itself and *Parens Patriae* for and on behalf of the People of the State of Mississippi

PLAINTIFF

vs.

THE CITY OF MEMPHIS, TENNESSEE; and MEMPHIS LIGHT, GAS & WATER DIVISION

DEFENDANTS

ORDER DENYING MOTION FOR JUDGMENT ON THE PLEADINGS AND DENYING MOTIONS FOR PARTIAL SUMMARY JUDGMENT

Presently before the court is the Defendants' motion for judgment on the pleadings and three separate motions for partial summary judgment as to damages prior to 1988, conversion, and prejudgment interest. Upon due consideration, the court finds that the motions should be denied.

The Plaintiff initiated this action seeking past and future damages as well as equitable relief related to the Defendants' alleged wrongful appropriation of groundwater from the Memphis Sands Aquifer, which belongs to the State of Mississippi. The Defendants have now filed the pending motions, one for judgment on the pleadings and three separate motions for partial summary judgment as to damages prior to 1988, conversion, and prejudgment interest. The Plaintiff opposes the motions.

Rule 12(c) provides that any party may move for judgment on the pleadings after the pleadings are closed but within such time as not to delay the trial. Fed. R. Civ. P. (12)(c). Rule 12(c) is designed to dispose of cases where the material facts are not in dispute and a judgment on the merits can be rendered by looking to the substance of the pleadings and any judicially noted facts." Herbert Abstract Co. v. Touchstone Props., Ltd., 914 F.2d 74, 76 (5th Cir. 2001). The central issue is whether, in the light most favorable to the plaintiff, the complaint states a valid claim for relief. Hughes v. Tobacco Inst., Inc., 278 F.3d 417, 420 (5th Cir. 2001). The standard for a motion to dismiss under Rule 12(c) is the same as for a motion to dismiss under Rule 12(b)(6) of the Federal Rules of Civil Procedure. Great Plains Trust Co. v. Morgan Stanley Dean Witter & Co., 313 F.3d 305, 313 (5th Cir. 2002); Jones v. Greninger, 188 F.3d 322, 324 (5th Cir.

1999). Thus, the court must accept all factual allegations in the complaint as true and take them in the light most favorable to the Plaintiff. Erickson v. Pardus, --- U.S. ----, 127 S.Ct 2197, 2200 (2007); Christopher v. Harbury, 536 U.S. 403, 406 (2002). A complaint must simply contain a short and plain statement of the claim showing that the pleader is entitled to relief, in order to give the defendant fair notice of what the claim is and the grounds upon which it rests. Bell Atl. Corp. v. Twombly, --- U.S. ----, 127 S.Ct. 1955, 1964 (2007) (quoting Conley v. Gibson, 355 U.S. 41, 47 (1957)). A complaint does not need detailed factual allegations, but a plaintiff's obligation to provide the grounds of his entitlement to relief requires more than labels and conclusions, and a formulaic recitation of the elements of a cause of action will not suffice. Id. at 1965 (citations omitted); Collins v. Morgan Stanley Dean Witter, 224 F.3d 496, 498 (5th Cir. 2000). The factual allegations must be enough to raise a right to relief above the speculative level on the assumption that all of the complaint's allegations in the complaint are true (even if doubtful in fact). Bell Atl. Corp., 127 S.Ct. at 1965.

As noted above, in ruling on a Rule 12(c) motion, the court will accept all well-pleaded facts as true, viewing them in the light most favorable to the plaintiff. Jones, 188 F.3d at 324 (5th Cir. 1999). In deciding whether to grant a 12(c) motion, the issue is not whether the plaintiff will ultimately prevail, but whether he is entitled to offer evidence to support his claim. Jones, 188 F.3d at 324. Judgment on the pleadings is appropriate only if material facts are not in dispute and questions of law are all that remain. Fed. R. Civ. P. 12(c); Voest-Alpine Trading USA Corp. v. Bank of China, 142 F.3d 887, 891 (5th Cir. 1998).

Given the stringent standard noted above, the court finds in this case that the Defendants' motion for judgment on the pleadings should be denied. As the court noted in previous orders denying motions to dismiss filed by the Defendants, a plethora of material facts are in dispute in this case and judgment on the pleadings is simply not appropriate. Accordingly, the Defendants' present motion for judgment on the pleadings is denied.

As for the Defendants' motions for partial summary judgment, the court finds that genuine issues of material fact exist at the present juncture which preclude the entry of partial summary judgment as to damages prior to 1988, conversion, and prejudgment interest. Further, the court has the discretion, which it exercises here, to allow the subject claims to proceed to trial. See Anderson v. Liberty Lobby. Inc., 477 U.S. 242, 255, 106 S. Ct. 2505, 2513, 91 L. Ed. 2d 202 (1986) ("Neither do we suggest ... that the trial court may not deny summary judgment in a case where there is reason to believe that the better course would be to proceed to a full trial.").

THEREFORE, it is hereby ORDERED that the Defendants' motion for judgment on the pleadings and three separate motions for partial summary judgment as to damages prior to 1988, conversion, and prejudgment interest (docket entries 186, 224, 226, and 232) are DENIED.

SO ORDERED, this the 24th day of September 2007.

/s/ Glen H. Davidson
Senior Judge

APPENDIX D

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT
OF MISSISSIPPI
DELTA DIVISION

No. 2:05CV32-D-B

[Filed September 13, 2005]

JIM HOOD, Attorney General, *ex rel.*, THE STATE OF MISSISSIPPI, acting for itself and *Parens Patriae* for and on behalf of the People of the State of Mississippi	)
PLAINTIFF	)
vs.	)
THE CITY OF MEMPHIS, TENNESSEE; and MEMPHIS LIGHT, GAS & WATER DIVISION	)
DEFENDANTS	)

ORDER DENYING MOTION TO ALTER OR AMEND

Presently before the court is the Defendants' motion to alter or amend the court's August 8, 2005, order denying the Defendants' motion to dismiss. Upon due consideration, the court finds that the motion,

which is in essence a motion to reconsider, should be denied.[1]

On February 1, 2005, the Plaintiff initiated this action seeking past and future damages as well as equitable relief related to the Defendants' alleged wrongful appropriation of groundwater from the Memphis Sands Aquifer, which belongs to the State of Mississippi. Thereafter, the Defendants filed a motion to dismiss, which the court denied on August 8, 2005. In the present motion, filed pursuant to Rule 60(b) of the Federal Rules of Civil Procedure, the Defendants seek to have the court reconsider its decision, and alter or amend its August 8, 2005, order.

Rule 60 of the Federal Rules of Civil Procedure allows relief from a judgment or order for various reasons, including clerical errors, newly discovered evidence, fraud, or "any other reason justifying relief from the operation of the [order]." Fed. R. Civ. P. 60(b). Here, the Defendants have requested relief solely on the basis that they disagree with the court's prior ruling, and they insist that they are in fact entitled to a dismissal of the Plaintiff's claims.

It was only after careful consideration of the parties' submissions that the court entered its order

---

[1] The Defendants also request that the court certify the issues presented in this motion for interlocutory appeal, pursuant to 28 U.S.C. §1292(b). The court finds, however, that these issues do not involve any controlling questions of law as to which there is substantial ground for difference of opinion. As such, the court finds that its denial of the Defendants' motion to dismiss does not present issues of sufficient magnitude so as to warrant an interlocutory appeal.

denying the Defendants' motion to dismiss. In the present motion to alter or amend, the Defendants do not assert any new arguments, facts or case law that would give the court any reason to modify its prior ruling in any respect. As such, the court is satisfied that its prior ruling is not in error, and the court declines to alter or amend that ruling.

THEREFORE, it is hereby ORDERED that the Defendants' motion to alter or amend (docket entry 48) is DENIED.

SO ORDERED, this the 12th day of September 2005.

/s/ Glen H. Davidson
Chief Judge

APPENDIX E

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT
OF MISSISSIPPI
DELTA DIVISION

No. 2:05CV32-D-B

[Filed August 9, 2005]

JIM HOOD, Attorney General, ex rel.,
THE STATE OF MISSISSIPPI

PLAINTIFF

VS.

THE CITY OF MEMPHIS, TENNESSEE,
AND MEMPHIS LIGHT, GAS & WATER
DIVISION

DEFENDANTS

ORDER DENYING MOTION TO DISMISS

Presently before the Court is the Defendants' motion to dismiss. Upon due consideration, the Court finds that the motion should be denied.

The Plaintiff initiated this action seeking past and future damages as well as equitable relief related to

the Defendants' alleged wrongful appropriation of ground water from the Memphis Sands Aquifer which belongs to the State of Mississippi. The Defendants challenge the complaint on a variety of legal grounds none of which the Court finds persuasive. The Court has carefully reviewed the parties comprehensive briefs and finds that the Plaintiff does have standing and the claims are ripe, the State of Tennessee is not an indispensable party, this Court does have subject matter jurisdiction and venue is proper. Thus, the Defendants' motion to dismiss shall be denied in all respects.

THEREFORE, it is hereby ORDERED that the Defendants' motion to dismiss (docket entry 21 shall be DENIED.

SO ORDERED, this the 8th day of August 2005.

/s/ Glen H. Davidson
Chief Judge

APPENDIX F

CONSTITUTION OF THE UNITED STATES OF AMERICA ARTICLE III. JUDICIAL POWER

U.S. Const. Art. III, § 2

The judicial Power shall extend to all Cases, in Law and Equity, arising under this Constitution, the Laws of the United States, and Treaties made, or which shall be made, under their Authority;--to all Cases affecting Ambassadors, other public Ministers and Consuls;--to all Cases of admiralty and maritime Jurisdiction;--to Controversies to which the United States shall be a Party;--to Controversies between two or more States;--between a State and Citizens of another State;--between Citizens of different States,--between Citizens of the same State claiming Lands under Grants of different States, and between a State, or the Citizens thereof, and foreign States, Citizens or Subjects.

In all Cases affecting Ambassadors, other public Ministers and Consuls, and those in which a State shall be Party, the supreme Court shall have original Jurisdiction. In all the other Cases before mentioned, the supreme Court shall have appellate Jurisdiction, both as to Law and Fact, with such Exceptions, and under such Regulations as the Congress shall make.

The Trial of all Crimes, except in Cases of Impeachment, shall be by Jury; and such Trial shall be

held in the State where the said Crimes shall have been committed; but when not committed within any State, the Trial shall be at such Place or Places as the Congress may by Law have directed.

UNITED STATES CODE
TITLE 28. JUDICIARY AND
JUDICIAL PROCEDURE
PART IV. JURISDICTION AND VENUE
CHAPTER 81. SUPREME COURT

28 U.S.C.§ 1251. Original jurisdiction

(a) The Supreme Court shall have original and exclusive jurisdiction of all controversies between two or more States.

(b) The Supreme Court shall have original but not exclusive jurisdiction of:

(1) All actions or proceedings to which ambassadors, other public ministers, consuls, or vice consuls of foreign states are parties;

(2) All controversies between the United States and a State;

(3) All actions or proceedings by a State against the citizens of another State or against aliens.

MISSISSIPPI CODE of 1972 ANNOTATED
TITLE 51. WATERS, WATER RESOURCES, WATER DISTRICTS, DRAINAGE, AND FLOOD CONTROL
CHAPTER 3. WATER RESOURCES; REGULATION AND CONTROL
ARTICLE 1. GENERAL PROVISIONS

Miss. Code Ann. § 51-3-1. Declaration of policy on conservation of water resources

It is hereby declared that the general welfare of the people of the State of Mississippi requires that the water resources of the state be put to beneficial use to the fullest extent of which they are capable, that the waste or unreasonable use, or unreasonable method of use, of water be prevented, that the conservation of such water be exercised with the view to the reasonable and beneficial use thereof in the interest of the people, and that the public and private funds for the promotion and expansion of the beneficial use of water resources shall be invested to the end that the best interests and welfare of the people are served.

It is the policy of the Legislature that conjunctive use of groundwater and surface water shall be encouraged for the reasonable and beneficial use of all water resources of the state. The policies, regulations and public laws of the State of Mississippi shall be interpreted and administered so that, to the fullest extent possible, the ground and surface water resources within the state shall be integrated in their use, storage, allocation and management.

All water, whether occurring on the surface of the ground or underneath the surface of the ground, is

hereby declared to be among the basic resources of this state to therefore belong to the people of this state and is subject to regulation in accordance with the provisions of this chapter. The control and development and use of water for all beneficial purposes shall be in the state, which, in the exercise of its police powers, shall take such measures to effectively and efficiently manage, protect and utilize the water resources of Mississippi.

APPENDIX G

In the
Supreme Court of the United States

No. _____, Original

THE STATE OF MISSISSIPPI,
Plaintiff,
v.

THE CITY OF MEMPHIS, TENNESSEE,
MEMPHIS LIGHT, GAS & WATER DIVISION,
AND THE STATE OF TENNESSEE
Defendants.

AFFIDAVIT OF ALAN B. CAMERON

STATE OF MISSISSIPPI)
) ss.
COUNTY OF LAFAYETTE)

I, Alan B. Cameron, one of the counsel of record for Plaintiff, the State of Mississippi ("Mississippi"), being first duly sworn, do hereby swear and affirm under oath the following:

1. My name is Alan B. Cameron. I am over twenty-one (21) years of age and I am competent to make this Affidavit. This Affidavit is based on my personal knowledge.

2. I am counsel of record for Mississippi in the above-styled and numbered cause. I am submitting this Affidavit solely in my capacity as attorney for Plaintiff and not as a real party-in-interest or potential witness in this or any related proceedings. This Affidavit is submitted in my capacity as counsel of record for the purpose of identifying, describing and authenticating certain documents and materials Plaintiff, Mississippi, believes essential to understand the Motion for Leave to File Bill of Complaint in Original Action pursuant to Supreme Court Rule 17 invoking the Court's original and exclusive jurisdiction under Article III, Section 2 of the Constitution of the United States and its implementing statute, 28 U.S.C. §1251(a). The documents and materials annexed hereto are comprised predominantly of excerpts from expert reports from the Record on Appeal to the Fifth Circuit Court of Appeals (as evidenced by the alphanumerical designation at the lower right corner of each page of such excerpts beginning with the designation "USCA5"), as well as reports, studies and governmental records prepared and disseminated publicly with the direct authorization, participation and knowledge of all Defendants named herein.

3. Annexed hereto as "Exhibit 1" through "Exhibit 7" are true and correct copies of the following:

Exhibit 1 Affidavit of Charles T. Branch, former Director of the Office of Land and Water Resources of the Mississippi Department of Environmental Quality (without exhibits) [USCA5 1962 - USCA5 1966]

Exhibit 2 Affidavit of David A. Wiley, partner with the firm of Leggette, Brashears & Graham, Inc. and Professional Geologist certified by the American Institute of Professional Geologists [USCA5 2333 - USCA5 2337], with excerpts from his expert report entitled "Report on Diversion of Ground Water from Northern Mississippi Due to Memphis-Area Wellfields" dated May 2007, including the following:

- Cover Page, Table of Contents and Executive Summary [USCA5 2338 - USCA5 2344]
- Introduction and Background [USCA5 2345 - USCA5 2347]
- Hydrologic Evaluations [USCA5 2351 - USCA5 2352]
- Flow Net Methodology, Ground-Water Model Review, Description of Models, Ground-Water Model Simulations, Ground-Water Drawdown and Ground-Water Budget Analysis [USCA5 2352 - USCA5 2363]
- Evaluation of MLGW Pumpage on Mississippi Ground Water [USCA5 2363 - USCA5 2365]
- Conclusions [USCA5 2365 - USCA5 2368]

- 1886 Estimated Potentiometric Surface Map for Predevelopment Conditions, with Explanatory Note [This document was excerpted from Figure No. 30 from Wiley's Report (USCA5 2414)]

- Three-Dimensional Illustration Showing Cone of Depression, with Explanatory Note [This document was excerpted from Figure No. 5 from Wiley's Report (USCA5 2389)]

- Typical Cone of Depression Around a Well, with Explanatory Note [This document was excerpted from Figure No. 3 from Wiley's Report (USCA5 2387)]

- Flow Net Based on USGS 1980 Potentiometric Surface Map, with Explanatory Note [This document was excerpted from Figure No. 23 from Wiley's Report (USCA5 2407)]

- Flow Net Based on USGS 2000 Potentiometric Surface Map [USCA5 2411]

- Cone of Depression (Drawdown Area) from MLGW Pumpage, with Explanatory Note [This document was excerpted from Figure No. 4 from Wiley's Report (USCA5 2388)]

Exhibit 3 Excerpts from Final Expert Report of William G. Foster, Ph.D. (Market Economist; Damages Expert, May 31, 2007) (without exhibits, tables, etc.) [USCA5 2152 - USCA5 2169]

Exhibit 4 Excerpts from Preliminary Expert Report of William W. Wade, Ph.D., "Valuation of Mississippi-Owned Ground Water Used in MLGW Service Area" (December 29, 2006) (without portions of text, tables and schedules); Excerpts from Final Expert Report of William W. Wade, Ph.D.(Water Economist; Damages Expert), "Revisions & Additions to December 29, 2006 Report: Valuation of Mississippi-Owned Ground Water Used in MLGW Service Area" (May 31, 2007)) [USCA5 2197 - USCA5 2203; USCA5 2271 - USCA5 2288]

Exhibit 5 Tom Charlier, "Memphis Taps Into Desoto County's Water Levels," *The Commercial Appeal* (Monday, November 16, 1998) [USCA5 1990]

Exhibit 6 David Lewis Feldman, Ph.D., & Julia O. Elmendorf, J.D., "Final Report - Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need for Long-Term Planning," prepared for the Environmental Policy Office, Tennessee Department of Environment and Conservation (June 2000) [Excerpt re: Analysis of Memphis Sand Aquifer and

Memphis-MLGW liability to Mississippi] [USCA5 1992 - USCA5 2000]

Exhibit 7 John G. Morgan, Comptroller of the Treasury of the State of Tennessee (Office of Research), "*Special Report* - Tennessee's Water Supply: Toward a Long-Term Water Policy for Tennessee" (March 2002), disseminated to the Tennessee Speaker of the Senate, Speaker of the House of Representatives and Members of the General Assembly, and prepared by Dan Cohen-Vogel, Ph.D. (Principal Research Analyst) and Greg Spradley (Senior Research Analyst), Office of Research [excerpts pertaining to Memphis-MGLW's diversion of Mississippi's ground water from the Memphis Sand or "Sparta" Aquifer]

AND FURTHER AFFIANT SAITH NOT.

Executed, this the 20th day of August, 2009.

/s/_____
ALAN B. CAMERON

Subscribed and sworn to before me this 20th day of August, 2009, by ALAN B. CAMERON.

MY COMMISSION EXPIRES:

_____

/s/ Melissa D. Kitchens
NOTARY PUBLIC

[SEAL]

EXHIBIT 1

[USCA5 1962 - USCA5 1966]

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF MISSISSIPPI DELTA DIVISION

CIVIL ACTION NO. 2:05CV32-D-B

JIM HOOD, Attorney General, *ex rel.*, THE STATE OF MISSISSIPPI, Acting for Itself and *Parens Patriae* for and on behalf of the People of the State of Mississippi	)
PLAINTIFF	)
vs.	)
THE CITY OF MEMPHIS, TENNESSEE, AND MEMPHIS LIGHT, GAS & WATER DIVISION	)
DEFENDANTS	)

AFFIDAVIT OF CHARLES T. BRANCH

STATE OF MISSISSIPPI)
) ss.
COUNTY OF Holmes)

I, Charles T. Branch, being first duly sworn, do hereby swear and affirm under oath the following:

1. My name is Charles T. Branch. I am over twenty-one (21) years of age and I am competent to make this Affidavit. This Affidavit is based on my personal knowledge.

2. I was formerly the Director of the Office of Land and Water Resources ("OLWR") of the Mississippi Department of Environmental Quality ("MDEQ"), and predecessor agencies, from September 1979 until my retirement in June 2002. In my capacity as Director of OLWR, I was the Chief Administrator of that office charged with management, use and allocation of surface and groundwater resources of the State of Mississippi.

3. I am a Mississippi native, born in Attala County, Mississippi, on January 20, 1944. I was educated in the Town of Goodman, Holmes County, Mississippi. I attended Holmes County Community College for a period of two years and then matriculated to Mississippi State University where I graduated with a B.S. in Civil Engineering in January 1967. Later, in August 1969, 1I obtained a Master's Degree in Environmental Engineering at Mississippi State University. I went to work for International Paper Company in Mobile, Alabama in September 1969 as a Senior Design Engineer for wastewater control systems. I remained with International Paper Company until January of 1972, at which time I became employed with the United States Environmental Protection Agency in Atlanta, Georgia, Region IV, in the Enforcement Division. I was the Permit Coordinator for four states -- North Carolina, South Carolina, Tennessee, and Kentucky.

4. In March of 1974, I entered into a contractual arrangement with the Mississippi Air and Water Pollution Control Commission when the State of Mississippi was granted primacy to issue NPDES permits under the Clean Water Act. I remained in federal service with the EPA until March of 1976. In July 1976, I became employed exclusively with the Mississippi Air and Water Pollution Control Commission as a Senior Engineer. In the summer of 1978, I became the Chief of the Water Division of the Commission, and in September 1979, I became Director of the OLWR.

5. As Director of the OLWR for the MDEQ, and its predecessor agencies, I was in a position to formulate and enforce the policies of the State of Mississippi relative to the management and control of both surface and groundwater resources of the State. It was the policy of the State of Mississippi and the MDEQ that the State owned all of the surface water and groundwater resources within its territorial boundaries. It was this policy of state-ownership of surface and ground waters that provided the basic authority pursuant to which Mississippi, through MDEQ, controlled and regulated the water resources of the State.

6. During my tenure as Director of the OLWR of the MDEQ, Mississippi had three separate water quantity and quality permitting and enforcement statutes, each of which declared the basic policy of the State regarding Mississippi's ownership of its water resources.

7. In 1956, Mississippi became the first state east of the Mississippi River to adopt an appropriation

system for the permitting and management of surface water. The legislative enactment, codified in MISS. CODE ANN. §5956-01, contains a declaration confirming the policy of state-ownership, which states:

> Water occurring in any water course, lake or other natural water body of the State, is hereby declared to be among the basic resources of this state and subject to appropriation in accordance with the provisions of this Act, and the control and development and use of water for all beneficial purposes shall be in the State, which, in the exercise of its police powers, shall take such measures as shall effectuate full utilization and protection of the water resources of Mississippi.

A copy of the declaration of policy regarding the 1956 surface water permitting act is attached as Exhibit "1" to my Affidavit.

8. In July 1976, Mississippi enacted statutory provisions to provide for the creation of capacity use areas in relation to Mississippi's groundwater resources. The legislative declaration for that statutory scheme was codified in §51-4-1, which states:

> It is hereby declared that the general welfare and public interest of the state require that the water resources of the state be put to beneficial use to the fullest extent to which they are capable, subject to reasonable regulation in order to conserve those resources and to provide and maintain conditions which are conducive to the development and use of water resources. Groundwaters are hereby declared to be among

> the basic resources of this state and the control, development and use of water for all beneficial purposes shall be in the state, which in the exercise of its police powers shall take such measures as shall effectuate full utilization and protection of the groundwaters of Mississippi.

A copy of the legislative declaration of the groundwater capacity use act is attached as Exhibit "2" to my Affidavit.

9. In 1985, the Mississippi legislature enacted a statutory permitting regime relating to both surface water and groundwaters within the territorial boundaries of the State of Mississippi. With that act, Mississippi adopted a modern conjunctive water rights doctrine which reaffirmed that both surface water and ground water are owned by and property of the State of Mississippi. The legislative declaration of State policy in this regard is set forth in MISS. CODE ANN. §51-3-1 (1985 & Supp. 2006), which provides:

> All water, whether occurring on the surface of the ground or underneath the surface of the ground, is hereby declared to be among the basic resources of this state and therefore belong to the people of this state, and is subject to regulation in accordance with the provisions of this chapter. The control and development and use of water for all beneficial purposes shall be in the state, which, in the exercise of its police powers, shall take such measures to effectively and efficiently manage, protect and utilize the water resources of Mississippi.

A copy of the legislative declaration of policy for surface water and groundwater is attached as Exhibit "3" to my Affidavit.

10. Based on my personal knowledge and experience, and as a result of my work as Director of the OLWR of the MDEQ, I am personally familiar with and was directly involved in the implementation and enforcement of the policies of the State of Mississippi relative to surface water and groundwater resources. The policies governing the activities and enforcement powers of the OLWR are premised upon state-ownership of all water resources within the borders of the State of Mississippi. Mississippi has owned the waters within its borders since the time of statehood. As Mississippi's population grew, it became more important to manage and control through permitting and other enforcement powers the allocation and use of surface water and groundwater within the State. The statutes described in my Affidavit were based upon and express the policy of the State of Mississippi regarding its ownership of the waters of the State and the State's power, through its responsible agency, the MDEQ, to control, manage and protect the waters belonging to the State.

11. In the early 1990's, I personally became aware of the fact that pumpage by Memphis Light, Gas & Water Division of the City of Memphis created a cone of depression underlying Memphis that extended across the Mississippi-Tennessee border into Desoto County, Mississippi. As a result, Memphis' well fields were capturing substantial quantities of Mississippi's ground water due to pumping by Memphis Light, Gas & Water. In fact, during my tenure at the OLWR, it was determined that the City of Memphis was the user

of groundwater for municipal purposes in the State of Mississippi. I was personally aware of the fact that Memphis Light, Gas & Water's pumping centers were capturing substantial volumes of Mississippi's ground water. In 1994-95, my office attempted to convince Memphis Light, Gas & Water to cooperate in a jointly-funded research project in conjunction with the United States Geological Survey to perform a hydrologic assessment of the tertiary aquifers in northwestern Mississippi and adjacent Tennessee. The OLWR was concerned with both groundwater quantity and quality issues, particularly the diversion and withdrawal of Mississippi's groundwater into the Memphis area as a result of pumping by Memphis Light, Gas & Water. Based on my direct involvement in the attempts to coordinate and implement the joint study, I became aware that Memphis was not concerned with the water quantity issues that Mississippi wanted to address, and the joint project was never taken beyond a purely conceptual phase.

I declare under penalty of perjury that the foregoing is true and correct.

Executed, this 31st day of August, 2007.

/s/
CHARLES T. BRANCH

Subscribed and sworn to before me this 31st day of August, 2007, by CHARLES T. BRANCH.

MY COMMISSION EXPIRES: /s/ Lisa Lester
[SEAL] NOTARY PUBLIC

EXHIBIT 2

[USCA5 2333 - USCA5 2337]

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF MISSISSIPPI DELTA DIVISION

CIVIL ACTION NO. 2:05CV32-D-B

JIM HOOD, Attorney General, *ex rel.*, THE STATE OF MISSISSIPPI, Acting for Itself and *Parens Patriae* for and on behalf of the People of the State of Mississippi

PLAINTIFF

vs.

THE CITY OF MEMPHIS, TENNESSEE, AND MEMPHIS LIGHT, GAS & WATER DIVISION

DEFENDANTS

AFFIDAVIT OF DAVID A. WILEY

STATE OF FLORIDA)
) ss.
COUNTY OF TAMPA)

I, David A. Wiley, being first duly sworn, do hereby swear and affirm under oath the following:

1. My name is David A. Wiley. I am over twenty-one (21) years of age and I am competent to make this Affidavit. This Affidavit is based on my personal knowledge.

2. I am a partner with the firm of Leggette, Brashears & Graham, Inc. in the Tampa, Florida regional office. I am a Professional Geologist certified by the American Institute of Professional Geologists. My areas of experience and specialty include the design, operation and analysis of aquifer tests, safe-yield analyses for ground-water withdrawals from major public-supply well fields, computer model development, well field design and management, aquifer storage and recovery, ground-water system management, ground-water budget development and management and other areas of hydrogeology. A copy of my current resume is attached as part of "Appendix D" to my *"Report on Diversion of Ground-Water from Northern Mississippi Due to Memphis-Area Well Fields"* prepared for Jim Hood, Attorney General of the State of Mississippi, dated May 2007, a complete copy of which is attached to my Affidavit as Exhibit "1."

3. I was requested by the State of Mississippi to evaluate and report on the effects of ground-water flows in relation to the Memphis Sand or Sparta Aquifer ("the Aquifer") underlying northwestern Mississippi as a result of pumpage and ground-water withdrawals by Memphis Light, Gas & Water Division ("MLGW") of the City of Memphis, Tennessee ("Memphis"). Specifically, I was requested to confirm and quantify the volumes of Mississippi's ground water being diverted into the Memphis area as a result of MLGW pumpage. My analysis confirmed that MLGW's pumpage has altered the ground-water flow

direction of the Aquifer and has resulted in capturing ground water from beneath the State of Mississippi.

4. Based on my independent analysis of data available from MLGW and other sources, I have determined that MLGW's pumpage has created a cone of depression in the Aquifer and altered the natural flow path, resulting in the diversion of Mississippi's ground water. My evaluation shows that, over the period 1965 to 2006, 15% to 22% of MLGW's ground-water withdrawals were obtained from beneath Mississippi. For the year 2006, diversion of Mississippi's ground water equaled approximately 24 million gallons per day. I have calculated the total volume of ground water diverted from Mississippi due to MLGW pumpage since 1965 to be approximately 361.4 billion gallons (as of 2006).

5. My Expert Report, attached as Exhibit "1," addresses, among other things, the hydrologic cycle and ground-water budget analysis performed in connection with my evaluation and quantification of the impact of MLGW's pumpage on Mississippi's ground water. *See* Exhibit "1" at pp. 8-10 & 20-23.

6. The ground-water budget is an accounting of the ground-water component of the hydrologic cycle for any given area. It consists of the inflows and outflows for the specific area being studied. Inflows are comprised of recharge and ground-water inflow from upgradient adjacent areas. Outflows consist of ground-water outflow, storage depletion due to pumpage, and surface discharge. The total inflow and total outflow components for the ground-water budget should be equal to each other. If one of the outflow components in the budget changes, then either inflow

or other outflow components must change to balance the budget. For example, if the pumpage component increases, storage may be depleted, which will then have to be made up from another source. Recharge may increase, ground-water outflow may decrease, surface discharge may decrease, and ground-water inflow may increase.

7. The ground-water withdrawals by MLGW have created a large cone of depression that has extended down into northern Mississippi, primarily Desoto County. As a result of this cone of depression, the ground-water budget of the Aquifer has been altered. MLGW's pumpage has been diverting, and continues to divert, ground water from the Desoto County area of Mississippi in order to maintain the ground-water budget in Memphis to support MLGW's wellfields. This has resulted in an alteration to the ground-water budget in northern Mississippi, specifically Desoto County.

8. The ground-water budget in the areas encompassed by Shelby County, Tennessee, and Desoto County, Mississippi was, prior to any pumpage from MLGW wells, in steady-state flow condition. However, commencing in 1886, MLGW's pumpage and withdrawal of ground water from of the Aquifer disturbed the steady-state condition and created a dynamic flow condition. Due to increased pumpage from MLGW's wells, a significant amount of ground water crosses the boundary of Tennessee and Mississippi from Desoto County into the Memphis area to replace water that is being pumped by MLGW's wells. The amount of water flowing across the state line is in a dynamic state and varies due to pumpage amounts from MLGW's wells, specifically the wells

located closer to the State border. This is evident from the cone of depression depicted on potentiometric surface maps contained in my Expert Report at Figure Nos. 14-21, 23-28, 30-38 & Appendices "A" - "C."

9. There are a number of components comprising the water budget for the Memphis area, including recharge, storage, ground-water flow, and other factors. When a stress such as MLGW's pumpage is introduced to the system, it creates a cone of depression that gradually reaches out further and further to obtain more water to maintain the ground-water budget to supply MLGW's wells.

10. My analysis has shown that the cone of depression has grown large enough to extend into the State of Mississippi. It is capturing Mississippi's ground water, diverting it to the ground-water budget for Memphis to maintain the MLGW well pumpage. Billions of gallons of Mississippi's ground water have been permanently diverted into the MLGW hydrologic ground-water budget. The ground water that has been diverted from the ground-water system in Mississippi into Memphis has now become part of the hydrologic ground-water budget for Memphis. Absent total cessation of MLGW pumpage, the ground water will not flow back into Mississippi and is now under the influence of Memphis' well fields. MLGW's pumpage altered the ground-water system many decades ago. In fact, the cone of depression that has altered the flow path of water in Mississippi toward Memphis has been influencing the flow path of Mississippi's water since, at least, 1924. In other words, there have been diversions of Mississippi's ground water into the Memphis area dating back over 80 years. In my report, I have documented these diversions and quantified the

volumes of transboundary ground-water flow from Mississippi into the area of Memphis' ground-water budget from 1965 to 2006.

11. Because of the alteration of the ground-water budget, even if MLGW were to completely cease pumpage from its well fields, the ground water already diverted by Memphis would not return to Mississippi. MLGW's cessation of pumping would simply stop additional diversions in the future. Thus, due to MLGW's pumpage, it is my opinion that an aggregate of over 361.4 billion gallons of water (as of 2006) have been diverted into and will remain a part of the Memphis hydrologic ground-water budget. As a result, these volumes of ground water have been permanently lost to the State of Mississippi.

12. Once Mississippi's ground water is encompassed within Memphis' hydrologic ground-water budget, there is a continuous, ongoing process in which water that reaches MLGW's wells or well fields is constantly being replaced by water being diverted from Mississippi. Under standard hydrogeological principles, it is a basic fact that the volumes of Mississippi's ground water diverted and taken by Memphis have become part of the Memphis ground-water budget. Even so, I evaluated the ground-water modeling efforts of Defendants' experts, Messrs. Langseth and Robertson, to assess their position that water diverted from Mississippi, and admittedly encompassed now in Memphis' ground-water budget, has not actually, physically reached any of MLGW's wells. When I reviewed Defendants' experts' data and ran their model, I discovered that they have modified established, peer reviewed aquifer parameters and data values, such as

transmissivity, leakance, constant head and porosity factors, so as to favor the position advanced by Memphis or MLGW as described above. I performed an investigation to duplicate their approach and found -- using Defendants' experts' own data along with the peer reviewed, published historical data -- that MLGW wells are, and have been, diverting and withdrawing ground water originating from beneath Mississippi during the period covered by my report. Stated differently, using Defendants' experts' own data, I determined that ground water originating from Mississippi is, in fact, reaching MLGW's wells. This process will continue indefinitely into the future as long as MLGW's pumpage maintains or expands the cone of depression and continues to displace and capture Mississippi's water to supply MLGW's well fields as part of Memphis' hydrologic ground-water budget.

I declare under penalty of perjury that the foregoing is true and correct.

Executed, this the 4th day of September, 2007.

/s/
DAVID A. WILEY

Subscribed and sworn to before me this 4th day September, 2007, by DAVID A. WILEY.

MY COMMISSION
EXPIRES:
[SEAL]

/s/
NOTARY PUBLIC

[USCA5 2338 - USCA5 2344]

REPORT ON DIVERSION OF GROUND WATER FROM NORTHERN MISSISSIPPI DUE TO MEMPHIS AREA WELL FIELDS

Prepared For:

Jim Hood, Attorney General of the
State of Mississippi

May 2007

Prepared By:

LEGGETTE, BRASHEARS & GRAHAM,, INC.
Professional Ground-Water and Environmental
Engineering Consultants
10014 North Dale Mabry Highway, Suite 205
Tampa, FL 33618

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

REPORT ON DIVERSION OF GROUND WATER FROM NORTHERN MISSISSIPPI DUE TO MEMPHIS AREA WELL FIELDS

EXECUTIVE SUMMARY

Ground-water conditions can be affected by a number of things that include climatic conditions and hydrogeologic characteristics. But, in many instances ground-water conditions are impacted by pumpage from wells. Impacts due to well pumpage can be significant should the quantities withdrawn be significant, such as the MLGW well field operation in the Memphis, Tennessee area. The continual increase in ground-water withdrawals in the Memphis area has caused a long-term decline in ground-water levels in the Memphis Sand aquifer as observed in historical hydrographs and potentiometric surface maps for area monitoring wells and regional ground-water flow models.

It is our opinion that, as a result of ground-water pumpage (withdrawals) that has been occurring historically over, at least, the past four decades in the Memphis area, the natural ground-water flow direction or gradient of the aquifer has been significantly altered. This alteration of the gradient has extended into the ground-water system beneath northwestern Mississippi, primarily in DeSoto and Marshall Counties. As a result of Memphis area pumpage, the most significant amount of which is attributed to Memphis Light, Gas and Water Division of the City of Memphis, Mississippi ground water is now, and has been, flowing northward out of Mississippi into Memphis. This report demonstrates

this change in the aquifer flow gradient and the amount of ground water diverted annually from Mississippi into Memphis for the period of 1965 through 2006.

Based upon the Brahana Model, our own independent flow net analysis, potentiometric surface mapping, ground-water modeling, and our review of studies by other reputable scientists and water policy analysts (as discussed herein), it is our opinion that (1) Memphis area pumpage, primarily by MLGW, has altered the natural flow path and created a cone of depression in the Memphis Sand aquifer, resulting in the diversion of Mississippi's ground water; and (2) over the period of 1965 to 2006, an estimated 25 % to 35 % of Memphis area water supply has been derived from Mississippi. Further evaluation shows that 15 % to 22 % of MLGW's ground water withdrawals are obtained from ground water beneath Mississippi. For the year 2006, this diversion of Mississippi ground water equates to approximately 24 million gallons per day. It is very likely that unless ground-water withdrawal increases in either state change radically from those increases over the last 6 years, the volume of approximately 24 mgd being diverted from Mississippi will not change in the future. The total volume of ground water diverted from Mississippi due to MLGW pumpage since 1965 is calculated to be approximately 361.4 billion gallons.

[USCA5 2345 - USCA52347]

1.0 INTRODUCTION

Water supplies for various uses in the Memphis, Tennessee area have historically come from ground-water resources. Ground-water withdrawals from wells in the Memphis area have created a cone of depression in the Memphis Sand aquifer, which is the primary ground-water source. This cone of depression extends from Memphis in all directions including down into northern counties of Mississippi.

The purpose of this report is to present our evaluation of the effects on ground-water flows in relation to the Memphis Sand or Sparta aquifer underlying northwestern Mississippi as a result of pumpage or ground-water withdrawals in the Memphis area of Tennessee. **Figure 1** in this report shows the location of the project area. Our objective is to show that ground-water withdrawals occurring in the Memphis, Tennessee area, primarily by Memphis Light, Gas and Water (MLGW), are altering the ground-water flow direction and capturing ground water from beneath the state of Mississippi.

The tasks performed by Leggette, Brashears and Graham, Inc. (LBG) in order to accomplish our objective include: the review of existing technical reports and hydrologic data from the United States Geological Survey (USGS), University of Memphis Ground Water Institute (GWI), Memphis Light, Gas and Water (MLGW) and the Mississippi Department of Environmental Quality (MDEQ); review of existing ground-water flow models for the region; and performance of calculations to determine the volume of

ground water being pumped from the Memphis area that is coming from the Memphis Sand aquifer or Sparta aquifer beneath Mississippi. These calculations were performed using the flow net methodology and an existing ground-water flow model developed by the USGS. Additional information evaluated included an interview with J. Kerry Arthur (formerly of the USGS), a deposition of Dr. Randall Gentry (formerly with the GWI and now with the University of Tennessee) and a deposition of Charles H. Pickel (formerly a Manager at MLGW). It should be noted that there are limitations in this evaluation based on the current condition of the data available or provided from MLGW and the various agencies noted above. The conclusions expressed in this report are, thus, qualified based on data availability and quality. However, even though there are limitations, it is our opinion that the results in this evaluation are within an expected range consistent with information developed and conclusions presented by previous scientific evaluations. Those analyses, and ours, clearly demonstrate that Memphis area pumpage, particularly by MLGW, is and has been diverting and capturing large quantities of Mississippi's ground water.

2.0 BACKGROUND

Residents of DeSoto and Marshall Counties, Mississippi receive water from municipal water departments, rural water associations, or privately held water companies. The primary source of water for most water utilities in these counties is the Sparta aquifer of the Middle Claiborne Group, which outcrops in the county and ranges in thickness from 200 to 900 feet. In Tennessee, the Sparta aquifer, together with

the Zilpha, Winona and Tallahatta of the Middle Claiborne Group, and the Lower Claiborne-Upper Wilcox Formations are collectively known as the Memphis Sand aquifer.

The utility owned by the City of Memphis, MLGW, uses the Memphis Sand aquifer totally as its source for municipal water supply. MLGW operates over 170 wells from more than 10 well fields, three of which are in the southern part of the City and are approximately 2 to 3 miles north of the Tennessee/Mississippi State line just above DeSoto County. **Figure 2** shows the locations of the MLGW Well Fields.

Memphis began using the Memphis Sand aquifer as a municipal water supply in 1886. As of 1985 (Brahana & Broshears, 2001), Memphis area pumpage had risen to a rate of approximately 200 million gallons per day (mgd). The aquifer is being pumped at a higher rate than it is being recharged, causing water levels to drop and creating a cone of depression centered around and expanding outward from the City of Memphis. To better understand a cone of depression, **Figure 3** has been prepared to show pre-pumping and pumping conditions. The figure is a simple hydrogeologic cross section with a well in the center and the ground-water system shown in blue as being saturated. The non-pumping ground-water level is a horizontal dashed blue line that is labeled pre-pumping water table. The same cross section also shows that when the well is pumping the ground-water level around the well is drawn down. This drawdown of the ground-water level around the well forms a cone of depression as identified in **Figure 3** as a gold color. This cone of depression is actually in the shape of a cone as seen three dimensionally. The

shape and extent or size of the cone depends on the rate and duration of the pumping, and the hydraulic properties of the aquifer (ground-water system). Observations have shown that water levels in the Memphis Sand aquifer have declined (dropped) by as much as 100 feet since 1886 forming a large cone of depression. As part of this cone of depression, water levels under northern DeSoto County, Mississippi have been estimated from a USGS model (Arthur and Taylor, 1990) to have declined by up to 90 feet. In a deposition on March 27, 2007 of Charles H. Pickel, a retired MLGW water manager, he indicated that the cone of depression created by MLGW pumpage extended into northern Mississippi. This large cone of depression occurs as a result of cumulative ground-water pumping (multiple wells) primarily from well fields operated by MLGW in the Memphis area. Essentially, many smaller individual well cones of depression overlap forming one, large cone of depression. **Figure 4** illustrates the area of the larger cone of depression that occurs from the cumulative well field pumpage. **Figure 5** is a three-dimensional illustration showing the larger cone of depression. The Arthur and Taylor model shows that flows have been diverted from their natural westerly direction northward by the cone of depression in Memphis. As a result, the pumpage that has been occurring from the Memphis, Tennessee area is capturing ground water from the aquifer beneath Mississippi. The model also shows that the natural discharge of flow to shallower aquifers has been reversed, and flow from the surface has the potential to contaminate the aquifer. These conditions were recognized by David Feldman from the University of Tennessee prompting the publishing of a report titled Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need for

Long-Term Planning (June 2000), David Lewis Feldman, Ph.D., and Julia O. Elmendorf, J.D." In this report the author states that, at a ground-water pumping rate of approximately 145 million gallons per day (mgd) from the Memphis area a cone of depression is formed and 20-40 mgd is derived from beneath DeSoto County which is located in northwestern Mississippi. The cone of depression of the Memphis Sand can also be seen in potentiometric surface contour maps presented by Moore, 1960; Criner and Parks, 1976; and Parks, 1990. **Appendix A** contains the maps from these three reports.

3.0 HYDROGEOLOGY

The hydrogeology of the Memphis and northern Mississippi area has been described by others over the years. There are a number of principal aquifers and confining units delineated in this area. The major hydrogeologic units are: Surficial aquifer of Quaternary age consisting of the Fluvial deposits and the Alluvium; the Jackson-upper Claiborne Formation; the Memphis Sand; the Flour Island Formation; and the Fort Pillow Sand, all of Tertiary age (Outlaw, 1994). **Figure 6** is a generalized hydrogeologic cross section showing these units. Following are descriptions of each of these hydrogeologic units as delineated by Graham and Parks in 1986.

[USCA5 2351 - USCA5 2368]

5.0 HYDROLOGIC EVALUATIONS

Ground-water conditions can be affected by a number of things that include climatic conditions and hydrogeologic characteristics. But, in many instances ground-water conditions are impacted by pumpage from wells. Impacts due to well pumpage can be significant should the quantities withdrawn be significant, such as the MLGW well field operation in the Memphis, Tennessee area. In order to achieve our objective of determining the effects on ground-water flows in relation to the Memphis Sand or Sparta aquifer underlying northwestern Mississippi as a result of pumpage or ground-water withdrawals in the Memphis area of Tennessee, evaluation of hydrologic data is necessary.

As mentioned earlier in this report in the **BACKGROUND** section, Memphis began using the Memphis Sand aquifer, which is the principal aquifer in the region, as a municipal water supply in 1886. Since that time, Memphis area pumpage has risen to a rate of approximately 200 mgd (Brahana & Broshears, 2001). The continual increase in ground-water withdrawals in the Memphis area has caused a long-term decline in ground-water levels in the Memphis Sand aquifer. This ground-water level condition is observed in hydrographs for observation wells monitored by the Tennessee USGS. Hydrographs are developed from actual water level measurements collected in the field by USGS personnel. **Figures 9 through 13** show that water levels have declined from approximately 20 to 50 in these area observation wells since 1958.

The USGS has also prepared ground-water elevation maps of the potentiometric surface for the Memphis Sand aquifer that show the declining water-level conditions across the southwest Tennessee and northwest Mississippi area. Potentiometric surface is the ground-water level that water in an aquifer will rise to in a tightly cased well. Potentiometric surface maps illustrate the ground-water gradient across a given area. These potentiometric surface maps (**Figures 14 – 21**) have been prepared for the following years; 1960, 1970, 1980, 1988, 1990, 1995, 2000 and 2005. As with the hydrographs, the potentiometric surface maps are based on actual water-level measurements. Water levels in the Memphis Sand aquifer have declined by approximately 100 feet since 1886 forming a large cone of depression. Water levels in the Sparta aquifer (the equivalent in Mississippi to the Memphis Sand) under northern DeSoto County, Mississippi have been estimated from a USGS model developed by Arthur and Taylor, 1990, to have declined by up to 90 feet.

These potentiometric surface maps also provide information regarding ground-water gradient or flow direction which is always perpendicular to contours. The potentiometric maps in **Figures 14 – 21** all show that the ground-water flow direction in southwest Tennessee and northwest Mississippi is radial toward the center of Memphis where the lowest water levels are observed in the Memphis Sand. This rather large cone of depression seen on these figures occurs as a result of cumulative ground-water pumping (multiple wells) primarily from well fields operated by MLGW in the Memphis area. Ground-water gradient or flow direction will be discussed in the following section on **FLOW NET METHODOLOGY**.

5.1 Flow Net Methodology

A regional ground-water flow system is defined by a set of equipotential lines, boundary conditions, and corresponding flow lines. Equipotential lines are contour lines of the potentiometric surface elevations in an aquifer, as defined by water levels in wells open to a specific aquifer. Boundary conditions can be physical geologic features that define the extent of an aquifer, or hydraulic boundaries such as recharge and discharge boundaries. Flow lines define the direction of ground-water flow based on the configuration of the equipotential lines and boundary conditions. A flow net is a graphical representation of the ground-water flow system consisting of a set of equipotential lines and corresponding flow lines (Freeze and Cherry, 1979). It should be noted that the flow net method of analysis is a standard application utilized by hydrologists to calculate ground-water flow volumes driven by a gradient and is a relatively simple and straight forward process.

Flow nets are constructed from existing potentiometric surface contour maps, such as those published by the U.S. Geological Survey (USGS), or from ground-water model-derived potentiometric surface contour maps. Flow lines define the direction of ground-water from high potentiometric head to low potentiometric head using four basic rules: 1) flow lines and equipotential lines must intersect at right angles; 2) equipotential lines must meet impermeable boundaries at right angles; 3) equipotential lines must parallel constant head boundaries; and 4) if the flow net is constructed such that squares are created between two equipotential lines in one portion of the flow field, then squares must exist between these

equipotential lines across the flow field (Freeze and Cherry, 1979). Rules 1 and 4 are the basis for construction of a flow net to define the amount of flow through a specified portion of a regional ground-water flow system. Calculation of flow through a section of aquifer is based on the Darcy Equation:

$$q = K(dh/ds)(dm)(b)$$

where **K** is aquifer hydraulic conductivity, **dh** is the change in head between two adjacent equipotential lines, **ds** and **dm** are the dimensions of the square defined by an orthogonal set of equipotential line and flow lines (referred to as a flow tube), and **b** is the aquifer thickness. If the flow net is constructed based on a series of squares **(ds = dm)** across the area of interest, the total flow through the area of interest is calculated as:

$$Q = K(dh)(b)(m)$$

where **m** is the number of flow tubes across the area of interest. **Figure 22,** that is included in this report, illustrates the flow net concept as presented by Freeze and Cheery.

The flow nets used for this analysis were based on potentiometric surface maps from the USGS for the years 1980, 1988, 1990, 1995, 2000 and 2005. The potentiometric maps utilized were obtained from either USGS publications or its website. In the portion of Mississippi beyond the extent of equipotential lines on the USGS map, the equipotential lines were extended manually based on configurations derived from ground-water modeling results. The flow nets were based on a series of squares using two adjacent

equipotential lines located east of the major withdrawals in the Memphis area and along the border with DeSoto County, Mississippi. The flow lines were then extended upgradient and downgradient from the squares by maintaining right angles at the intersections with each equipotential line. The number of flow tubes that showed ground-water flowing from Mississippi into Tennessee was then totaled for calculation of the total ground-water flow from Mississippi.

Flow nets were constructed for the years 1980, 1988, 1990, 1995, 2000 and 2005, and are shown on **Figures 23 through 28** that are included in this report. Our flow net analysis indicated that flow of ground-water from Mississippi to Tennessee in the Memphis Sand aquifer was approximately 36.5 mgd in 1980, 39.8 mgd in 1988, 1990, and 1995, 43.2 mgd in 2000, and 33 mgd in 2005. The results of this analysis are somewhat confirmed from information reviewed from a deposition that took place on August 7, 2006 of Dr. Randall W. Gentry, a former Director of the Ground Water Institute at the University of Memphis. Of particular interest was a flow net analysis performed by Dr. Gentry in the 1999 to 2000 time frame. Dr. Gentry indicated that he estimated that about 25 % to 1/3 of the pumpage occurring in the Memphis, Tennessee area is derived from the ground-water system in Mississippi. He based his analysis on a potentiometric surface map prepared by the USGS for the 1988 period

Ground-water modeling was utilized to assist in calculating the ground-water flow contributions from Mississippi as a result of pumpage from the Memphis area and is described in the following section.

5.2 Ground-Water Modeling

Ground-water flow models are tools utilized by hydrogeologists and engineers to simulate a ground-water flow system. Assuming that hydrogeologic data is available for the area of concern, the hydrogeologist or engineer will first develop a conceptual model that is a simplified framework of the hydrogeologic system and is used to develop a ground-water flow model. Next, a model code is selected, such as MODFLOW to set up the model. A model grid is created to define the horizontal and vertical dimensions of the aquifer system. Boundary conditions are assigned to define the regional flow system. Aquifer characteristics are assigned to the model grid system of nodes or cells to define the hydraulic properties of the aquifer and confining layers. Recharge (rainfall), discharge (evapotranspiration and ground-water pumpage), and in some cases, streams, are included in the model to simulate the natural hydrologic cycle. The model is then run and the results are compared to observed ground-water level data from the area being evaluated. The input data are then adjusted until an acceptable match between observed and modeled water levels are obtained. This adjustment process is referred to as model calibration. The calibrated model is then used to perform predictive simulations.

In order to conduct our analysis for calculating the flow of ground water captured from Mississippi, as a result of pumpage from the Memphis area, it was determined that ground-water modeling was a necessary tool to utilize. After reviewing the literature, several candidate ground-water models were identified for potential use on this project. They were all

calibrated at the time of their development. Those models are discussed below.

5.2.1 Ground-Water Model Review

Three separate existing ground-water flow models were provided for review. The three models were:

1. Hydrogeology and Ground-Water Flow in the Memphis and Fort Pillow Aquifers in the Memphis Area, Tennessee, Water-Resources Investigations Report 89-4131 by J.V. Brahana and R.E. Broshears. U.S. Geological Survey. 2001.

2. A Ground Water Flow Model of the Northern Mississippi Embayment by David Kenley of Ground Water Institute, The University of Memphis, 1993.

3. A Ground Water Flow Analysis of the Memphis Sand Aquifer in the Memphis, Tennessee Area by Jamie Outlaw of Ground Water Institute, The University of Memphis, 1994.

5.2.2 Description of the Models

The following is a general description of each of the three ground-water flow models reviewed as part of our preliminary analysis:

1. ***Hydrogeology and Ground-Water Flow in the Memphis and Fort Pillow Aquifers in the Memphis Area, Tennessee, Water-Resources Investigations Report***

89-4131 by J.V. Brahana and R.E. Broshears. U.S. Geological Survey. 2001.

This is a regional ground-water model constructed by Brahana and Broshears to determine changes in regional flow from pre-development time to 1980 due to changes in pumpage in Memphis Sand and Fort Pillow aquifers. The geographic extent of the model grid area is shown in **Figure 29** included in this report. The report includes the hydrogeology of the Memphis Sand and the Fort Pillow aquifers in the Memphis, Tennessee area. The model grid consists of three-layers, which are, from top to bottom: a) Fluvial Deposits; b) Memphis Sand Aquifer; and c) Fort Pillow Aquifer. A brief summary of a description by Brahana and Broshears of the three aquifers (layers) is as follows:

a) Fluvial Deposits

Fluvial deposit occurs at land surface and it ranges in thickness from 0 to 100 feet. Thickness is highly variable, because of surfaces at both top and base (Graham and Parks, 1986). Locally, the fluvial deposits may be absent (Brahana and Broshears, 2001). The lithology of the fluvial deposits is primarily sand and gravel, with minor layers of ferruginous sandstone (Brahana and Broshears, 2001). Fluvial deposits are separated from the Memphis Sand aquifer by sediments of the Jackson Formation and the upper part of the Claiborne Group. There are no measurements of the hydraulic characteristics of the fluvial deposits in the Memphis area. However, based on the lithology, saturated thickness, and mode of occurrence, transmissivity is probably within the range of 5,000 to 10,000 ft2/d, and storage coefficient

probably is in the range of 0.1 to 0.2 (Freeze and Cherry, 1979). The reported seasonal water-level fluctuations in the fluvial deposits range from 2 to 10 feet (Wells, 1933, Graham, 1982, and Graham and Parks, 1986). However, long-term declines of water levels within the fluvial deposits have not been documented, except in the southern part of the Sheahan well field (Brahana and Broshears, 2001). The fluvial deposit within the model was represented as a constant head boundary layer.

b) Memphis Sand Aquifer

It is the most productive aquifer in the area and it contributed 98 percent of total pumpage (188 mgd) to the city of Memphis in 1980 (Graham, 1982; Brahana and Broshears, 2001). The lithology of the Memphis Sand aquifer varies from fine- to coarse grained sand interbedded with layers of clay and minor amounts of lignite (Brahana and Broshears, 2001). The Memphis Sand aquifer occurs at a depth from 0 to 600 feet and varies in thickness from 500 to 890 feet. The underlying aquifer below the Memphis Sand aquifer is the Fort Pillow aquifer, and it is separated by 140 to 310 feet of clay layer of the Flour Island Formation. The Memphis Sand aquifer is confined and overlying the aquifer is 0 to 370 feet clay and sandy clay of the Jackson Formation and the upper part of the Claiborne Group. As the thickness of the Jackson Formation and the upper part of the Claiborne Group varies, at places the Fluvial deposits aquifer sits directly above the Memphis Sand aquifer. Thus, leakage to the Memphis Sand aquifer from the surface Fluvial deposits is pronounced in many places.

The Memphis Sand aquifer in the Memphis area is reported to have a range of transmissivity from 6,700 to 54,000 ft^2/d, and range of storage coefficients from 1 X 10^{-4} to 2 X 10^{-1} (Criner et. al., 1964; Moore, 1965; Hosman et. al., 1968; Brahana, 1982a; Arthur and Taylor, 1990; Parks and Carmichael, 1989a).

c) Fort Pillow Aquifer

The Fort Pillow aquifer is the second most used aquifer after the Memphis Sand aquifer. The Fort Pillow aquifer comprises of fine to medium-grained sand containing clay lenses and minor amounts of lignite. The general thickness of the Fort Pillow aquifer is about 250 feet and ranges from about 125 to 305 feet. The Fort Pillow aquifer is confined above by 140 to 310 feet of clay of the Flour Island Formation (Brahana and Broshears, 2001). The Flour Island Formation is thought to be a leaky confining unit. The hydraulic conductivity of the Fort Pillow aquifer ranges from 25 to 470 ft/day. This corresponds to a range of transmissivity from about 670 to 85,000 ft^2/d. The storage coefficient is reported to range from 2 X $10^{-4}$to 1.5 X 10^{-2}. Hydraulic characteristics of the Fort Pillow aquifer within the Memphis area varies within a narrow range with the transmissivity varying between 12,000 to 19,000 ft^2/d, and the storage coefficient is reported to range from 1.2 X 10^{-4} to 6.1 X 10^{-4} (Criner et. al., 1964).

The Brahana and Broshears model is a transient ground-water model with hydrologic data from 1886 to 1980. The model is comprised of 8 stress-periods. The time frame of each stress period is as follows:

1) Stress period 1: 1886-1924 (40 years).

2) Stress period 2: 1925 – 1941 (17 years).

3) Stress period 3: (1942 – 1955) (13 years).

4) Stress period 4: (1956 – 1960) (5 years).

5) Stress period 5: (1961 -1965) (5 years).

6) Stress period 6: (1966 – 1970) (5 years).

7) Stress period 7: (1971 – 1975) (5 years).

8) Stress period 8: (1976 – 1980) (5 years).

The model was developed using the USGS finite difference ground-water flow code, MODFLOW (McDonald and Harbaugh, 1988). The model grid has 58 rows and 44 columns, with grid spacing varying between 3200 feet to 100,000 feet in the horizontal directions (north-south and east-west). Finer grid-spacing was done within the Memphis area. The interaction between the confining layers within the model is replicated by leakance terms, using the MODFLOW VCONT array. All the three layers in the model were simulated as a confined aquifer (LAYCON 0). The top layer of the model is represented as a constant head. However, it was noticed that within the model domain, in the second layer, Memphis Sand aquifer, pumpage wells were assigned within the constant heads near the eastern and southern part of the model boundaries. Ground-water withdrawals from the wells within the constant head will have no effect to the potentiometric surface or drawdown, and the model will not simulate those wells. Calibration was concentrated on stress periods from 1961 to 1980. Calibration was conducted by adjusting the global

multiplier of transmissivity, vertical conductance, and storage coefficients for the Memphis Sand and Fort Pillow aquifers, until the sum of the squared differences between observed and calculated heads were minimized (Brahana and Broshears, 2001). Pumpage was variable and increased with time in both the Memphis Sand and Fort Pillow aquifers.

2. ***A Ground Water Flow Model of the Northern Mississippi Embayment by David Kenley of Ground Water Institute, The University of Memphis, 1993.***

We reviewed the model data sets and performed model simulations to determine potentiometric surfaces within the model domain at the end of each stress period. A brief description of the model is provided below.

This is a three-dimensional ground-water flow model simulated using the USGS MODFLOW code. The model is based on Brahana and Broshears (2001) model, however, the time period of the model is extended from 1980 to 1993, with much finer grid-spacing in the Shelby County, Tennessee area. The model grid consists of 86 rows and 72 columns with grid spacing of the model varying between 3 to 100,000 feet in the east-west direction and 1600 to 100,000 feet in the north-south direction. The model had only two layers, the fluvial deposit aquifer and the Memphis Sand aquifer. It did not include the Fort Pillow aquifer. The conceptual model was altered for the Memphis Sand aquifer and it is represented as an unconfined aquifer (LAYCON 3), whereas in the Brahana and Broshears (2001) model it is represented as a confined layer (LAYCON 0). The purpose of the

model was to determine impact to the potentiometric surface due to ground-water withdrawals in the Shelby County, Tennessee area.

3. ***A Ground Water Flow Analysis of the Memphis Sand Aquifer in the Memphis, Tennessee Area by Jamie Outlaw of Ground Water Institute, The University of Memphis, 1994.***

The data sets from the "Jamie Outlaw model" were input into Groundwater Vistas (pre-and post-processor). The MODFLOW model is a steady-state model and was based on two regional ground-water flow models that had been previously developed. The first model was developed by USGS, Brahana and Broshears (2001) and the second by the Ground Water Institute, "David Kenley model." The model is composed of two layers with 350 rows and 600 columns with grids discretized into 500 feet by 500 feet in east-west and north-south directions. The model was calibrated to December, 1991 conditions. The first layer represents the Fluvial deposits and is represented as a constant head layer, whereas the second layer represents the Memphis Sand aquifer and represents an unconfined aquifer. The Fort Pillow aquifer was not simulated in the model because it was assumed that there is no interaction between the Memphis Sand aquifer and the Fort Pillow aquifer due to an impermeable layer separating the two aquifers. This flow model also indicates that much of the water entering Shelby County originates to the southeast in DeSoto and Marshall Counties, Mississippi.

5.3 Ground-Water Modeling Simulations

It was decided that the USGS model by Brahana and Broshears (2001) was appropriate to use for all model simulations in this evaluation. The Brahana and Broshears (2001) model was used because it includes both the Memphis Sand aquifer as well as the Fort Pillow aquifer. Even though the "David Kenley" and "Jamie Outlaw" models were derived from Brahana and Broshears (2001) model, they were not considered since they only include the Fluvial deposits and Memphis Sand aquifer and do not include the Fort Pillow aquifer. The Fort Pillow aquifer is one of the major aquifers and not simulating its heads is likely to under-predict its contribution and affect the regional ground-water budget.

For this project, water-level conditions of the Memphis Sand aquifer were of primary interest. It was stated in a report by Brahana, 1981, that the Memphis Sand aquifer alone appears to have the capability to supply all the projected needs for water for the Memphis metropolitan area without using either of the two alternative ground-water sources; i.e. the Alluvial and Fort Pillow aquifers. As indicated in Mississippi's First Amended Complaint, claims for damages in this case are only related to the Memphis Sand aquifer (or Sparta aquifer, as it is referred to in Mississippi) and not the Fluvial Deposits or the Fort Pillow aquifer. Even so, it should be noted that there is a possibility that, at a later date, additional claims could be made by Mississippi regarding withdrawals associated with the Fort Pillow aquifer.

The MODFLOW input data files were input into Groundwater Vistas (ESI, 2006). Groundwater Vistas

is a pre- and post-processor and includes USGS MODFLOW code to perform numerical simulations.

Pre-development simulation was conducted by turning off the well package of MODFLOW. **Figure 30** included in this report, shows the model-computed potentiometric surface of the Memphis Sand aquifer prior to 1886, which is considered to represent pre-development or pre-pumping conditions. This figure shows that the pre-development ground-water flow direction for the Memphis Sand aquifer was from east to west toward the Mississippi River. This pre-development potentiometric surface map was presented by Brahana, 2001 and has been published by others who have performed hydrologic analyses in the region. Post-development modeling scenarios were initially conducted from 1924 to 1980. The post-development includes changes in hydraulic stress due to pumpage in the Memphis Sand and Fort Pillow aquifers. **Figure 31** contained in this report, shows the potentiometric surface at the end of the 1980 stress period in the Memphis Sand aquifer. During the post-development stage, i.e., in the year 1980, the potentiometric surface in the Memphis area was significantly altered due to pumpage in the Memphis Sand aquifer (**Figure 31**) as evidenced by the shapes of the contours on the figure. The "bull's-eye" areas in the figure are indicative of significant drawdown or cones of depression. The bending of the potentiometric contours in northwest Mississippi (Desoto County) indicates that ground-water pumpage occurring in the Memphis area is affecting ground-water conditions in Desoto County. This same affect on ground-water levels in northwest Mississippi can be seen from work performed by others including Arthur and Taylor, 1990; Kenley, 1993; and Outlaw, 1994. **Appendix B**

contains figures from each of these three reports that show water-level contour maps for the potentiometric surface of the Memphis Sand aquifer. All of the maps show a cone of depression extending into northwest Mississippi.

Since the original Brahana and Broshears model was developed only through 1980 it was to update the model in order to begin evaluating more current conditions. LBG updated the Brahana and Broshears model for the period of 1983 to 1993 using pumpage data from the "David Kenley model." The updated model includes a total of eleven (11) stress periods. Since the "David Kenley model" did not include the Fort Pillow aquifer, the Fort Pillow aquifer in the updated Brahana and Broshears (2001) model was assigned the 1980 pumpage rates to the additional stress periods from 1983 to 1993.

Since the objective of this project is to calculate the flow of ground water from Mississippi to Memphis as a result of ground-water pumping to as near the current as possible, it was decided to further update the model. This was deemed necessary since ground-water data were not readily available to prepare potentiometric surface maps. In order to further update the model, pumpage data were necessary. Pumpage data from several sources were reviewed for use in this modeling exercise. These sources included the USGS Water Use Estimates reports, MLGW production reports and pumpage estimates for various utilities in Mississippi. We also utilized population estimates and projections where necessary. The model was then updated through 2005 by including several additional stress periods. Potentiometric surface maps for 1995, 2000 and 2005

are shown respectively, on **Figures 32 - 34**. These maps are similar to potentiometric surface maps presented earlier in the report (**Figures 19-21**), which are based on actual water-level data collected by the USGS. These relatively good comparisons provide confidence in the updated model.

5.4 Ground-Water Drawdown

Ground-water drawdown at the end of each stress period was determined by subtracting the ground-water heads after each stress period from the pre-development ground-water heads. Drawdown in the Memphis area significantly increased with time in the Memphis Sand aquifer for the year 1980 as shown on **Figure 35**. In the Memphis area, drawdown in some places was as much as 100 feet in the Memphis Sand aquifer. This figure shows the extent of the cone of depression formed for the Memphis Sand aquifer as a result of the ground-water pumpage.

The drawdown contours in the Memphis Sand aquifer tends to be longitudinally oriented, between the Mississippi River and the aquifer outcrop in the east. Due to the higher heads of the Mississippi River (simulated in the model as a constant head in layer -1), an effective hydrologic boundary is created and preventing the drawdown cone of depression from moving out into Arkansas. The Memphis Sand aquifer outcrops to the east in Tennessee and in many places it gets direct recharge from precipitation, and as a result the cone of depression is prevented from moving further out in the east. **Figures 36 through 38** contained in this report, show the cone of depression or drawdown by as much as 120 feet for the 1995, 2000 and 2005 periods, respectively, in the Memphis Sand

aquifer using the updated Brahana and Broshears model.

5.5 Ground-Water Budget Analysis

A ground-water budget analysis was conducted using the updated Brahana and Broshears model which includes the time period from 1886 to 2005. The ground-water budget represents the components of inflows, outflows and changes in storage to the aquifer. Ground-water budget analysis for the Memphis area was conducted using the U.S. Geological Survey MODFLOW model (Brahana and Broshears, 2001). Prior to running the ground-water model, each of the counties, such as Desoto, Shelby, etc. were provided a unique zone number in the pre-processor (Groundwater Vistas, Environmental Simulations, Inc). These unique zone numbers are important to distinguish and determine the ground-water inflows, outflows, and storage within each county after the numerical simulations. Once the simulations are completed the cell-by-cell flow data for each of the zone is calculated for a specified time interval, which provides the amount of inflow and outflow such as pumping wells, constant heads, and storage out and into the county. The ground-water budget also provide amount of net flow being contributed by one county to another county due to stress in the system such as pumping wells. The net flow indicates the difference of flow from the developmental conditions to pre-development conditions (i.e., prior to any pumpage).

The focus of the budget analysis was to determine the net ground-water flow to the Shelby County, Tennessee area from DeSoto and Marshall Counties,

Mississippi. **Figure 39** included in this report shows a plot of net flow of ground water to the Shelby County area under the influence of Memphis area pumpage. The contribution of ground water from Desoto and Marshall Counties has steadily increased with time. In 1924 the contribution from DeSoto and Marshall Counties was 4.18 mgd, whereas in 1993 the contribution was 35.57 mgd. This increased flow from DeSoto and Marshall Counties to Shelby County is attributed to an increase in pumpage from the Memphis area, most of which is attributable to MLGW. The high pumpage creates a cone of depression that stretches as far south as DeSoto County with pronounced drawdown near the political boundary between Shelby County and DeSoto County. Some of the largest wellfields of Shelby County, such as Davis and Lichterman wellfields operated by MLGW, are very close to the state boundary between Tennessee and Mississippi causing significant drawdown and ground-water flow from DeSoto County to Shelby County in the Memphis area. Moore in 1960 also presented a ground-water budget for the Memphis area. His analysis, which was based on 1960 data, shows that 25 mgd of ground water is derived as underflow through the Memphis Sand aquifer from Mississippi. The results depicted in **Figure 39** are in the same range of values reported by Moore in 1965, Criner in 1964, Feldman in 2000, Gentry in 2000 and Arthur in 2006.

After 1993 to 2005, the contribution from DeSoto and Marshall Counties to Shelby County decreased to 33.27 mgd. This decrease can be observed on **Figure 39** and in **Table 1** included in this report. Even though pumpage in the Memphis area increased, the decrease in contribution from DeSoto and Marshall Counties

likely resulted from increases in pumpage from DeSoto County, which reduces the amount of ground water available to flow into Shelby County. Pumpage amounts in the model for each county can be observed in **Figure 40** and in **Table 2** included in this report.

It is our opinion that based on our hydrologic evaluation and from the review of technical reports, ground-water pumpage from the Memphis area has created a large cone of depression that has altered natural aquifer flow paths, and as a result is capturing ground-water from beneath the state of Mississippi.

6.0 EVALUATION OF MLGW PUMPAGE ON MISSISSIPPI GROUND WATER

It is clear from our review of a number of technical reports described previously that a large cone of depression of the potentiometric surface for the Memphis Sand aquifer has been developed as a result of ground-water pumpage from the Memphis, Tennessee area. Most of this pumpage that is diverting Mississippi's ground water is attributable to MLGW. This cone of depression extends into northern Mississippi and has altered the ground-water gradient. The ground-water gradient of the Memphis Sand aquifer has been altered from its natural east to west flow direction to a northerly direction.

MLGW is by far the largest ground-water user in the area. They operate over 170 wells from more than 10 well fields for providing water supply to the City of Memphis and surrounding area. Wells in these 10 well fields withdraw ground water from the Memphis Sand aquifer, which is the principal aquifer in the region. Table 3 lists historical pumpage for the 10 well fields.

Figures 41-43 are bar charts that show historical pumpage for each well field and the total for the well fields cumulatively. The total well field chart at the bottom of Figure 43 shows a continual increase in MLGW pumpage from 1965 through 2006.

It was decided that since MLGW is by far the largest ground-water used in the area, the impacts from MLGW pumpage only from the Shelby County area should be evaluated. In order to accomplish this, the Brahana and Broshears model was utilized. For this exercise, all ground-withdrawals, with the exception of those for the 10 MLGW well fields and those in northern Mississippi (primarily Desoto County), were removed from the model set-up. The model was then rerun utilizing historical pumpage since 1965 to 2006. The purpose of this modeling exercise was to determine the amount of drawdown, extent of the cone of depression and volume of ground water diverted from northern Mississippi due to MLGW pumpage. Appendix C of this report contains a series of potentiometric surface and drawdown maps showing the effects of pumping every five years beginning in 1965 through 2006. It is clear from the review of these maps that MLGW pumpage has caused a cone of depression that extends well into northern Mississippi. The potentiometric surface map for 2006 clearly shows that the pre-development ground-water flow direction from east to west in northwestern Mississippi has been altered and is now a more northerly direction towards the MLGW pumping centers. The drawdown map for 2006 also clearly shows that a large cone of depression has formed due to MLGW pumpage and extends well into Desoto County Mississippi. The map shows that a great deal of Desoto County experiences more than 10 feet of

drawdown due to MLGW pumpage. In the extreme north-central part of Desoto County, more than 20 feet of drawdown occurs as a result of MLGW pumpage.

Presented earlier in this report are information developed by LBG and others that indicates ground water is flowing from Mississippi to the Memphis area due to large amounts of pumpage occurring in the Memphis area. The ground-water flow modeling that has been presented in this section of the report that addresses MLGW pumpage also shows that ground water is flowing from Mississippi to the Memphis area due to the MLGW pumpage. A ground-water budget analysis was also performed from this modeling effort to determine the amount of ground water that is diverted from northern Mississippi to the Memphis area due to MLGW pumpage. Ground-water budget represents the components of inflows, outflows and changes in storage to the aquifer. A detailed description of budget analysis using MODFLOW was presented earlier in this report. **Figure 44** is a graph showing the ground-water flow volumes contributed by each county surrounding the Memphis area as a result of MLGW pumpage for the years 1965 through 2006. Desoto and Marshall Counties in Mississippi are of interest in this evaluation since they are in northern Mississippi. The total volumes for those two counties for each year from 1965 through 2006 are presented in **Table 4**. For example, the volume of water diverted from Desoto and Marshall Counties in 2006 is 24.1 mgd. In fact, the total volume of ground water diverted from Mississippi due to MLGW pumpage since 1965 is calculated to be approximately 361.4 billion gallons.

It is interesting to observe that in **Table 4** starting in the early 1990s the volumes diverted from

Mississippi begin to continually decrease. The largest volume of 28.2 occurred in 1988. This decrease can also be observed on **Figure 44**. Even though MLGW pumpage continued to increase from 1965 through 2006, the decrease in contribution from DeSoto and Marshall Counties likely resulted from increases in pumpage from DeSoto County, which reduced the amount of ground water available to flow into Shelby County. As a result, the increased pumpage in DeSoto County is preventing the increased pumpage from MLGW to capture some of the ground water from the northern Mississippi area. Based on the volumes shown in **Table 4** beginning in 2001, it appears that some stabilization of the volume of water contributed from Desoto and Marshall Counties has stabilized. Therefore, it is very likely that unless ground-water withdrawal increases in either state change radically from those increases over the last 6 years, the volume of approximately 24 mgd being diverted from Mississippi will not change in the future.

7.0 CONCLUSIONS

The primary purpose of our preliminary investigation as presented in this report is the evaluation of the effects on ground-water flows in northwestern Mississippi as a result of ground-water pumpage in the Memphis area of Tennessee, most of which is attributable to MLGW. This evaluation included the review of existing technical reports and hydrologic data from the USGS, University of Memphis GWI, MLGW and the MDEQ and the performance of calculations to determine the volume of ground water that is coming from the aquifer beneath Mississippi due to pumping from the Memphis area, focusing on MLGW. These calculations were performed

using the flow net methodology and an existing ground-water flow model developed by the USGS.

It is clear from our review of a number of technical reports described previously that a large cone of depression of the potentiometric surface for the Memphis Sand aquifer has been developed as a result of ground-water pumpage from the Memphis, Tennessee area. Most of this pumpage that is diverting Mississippi's ground water is attributable to MLGW. This cone of depression extends into northern Mississippi and has altered the ground-water gradient. The ground-water gradient of the Memphis Sand aquifer has been altered from its natural east to west flow direction to a northerly direction. This finding is also confirmed from our review of water-level data associated with potentiometric surface maps prepared by the USGS and from ground-water flow modeling. Observations have shown that water levels in the Memphis Sand aquifer have declined (dropped) by as much as 100 feet since 1886 forming a large cone of depression. As part of this cone of depression, water levels under northern DeSoto County, Mississippi have been estimated from a USGS model (Arthur and Taylor, 1990) to have declined by up to 90 feet. In a deposition on March 27, 2007 of Charles H. Pickel, a retired MLGW water manager, he indicated that the cone of depression created by MLGW pumpage extended into northern Mississippi. These conditions were recognized by David Feldman from the University of Tennessee prompting the publishing of a report titled "Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need for Long-Term Planning (June 2000), David Lewis Feldman, Ph.D., and Julia O. Elmendorf, J.D." In this report the author states that, at a ground-water

pumping rate of approximately 145 million gallons per day (mgd) from the Memphis area a cone of depression is formed and 20-40 mgd is derived from beneath DeSoto County which is located in northwestern Mississippi. The cone of depression of the Memphis Sand can also be seen in potentiometric surface contour maps presented by Moore, 1960; Criner and Parks, 1976; and Parks, 1990.

Flow net analysis was performed utilizing several USGS potentiometric surface maps. These maps were constructed for the years 1980, 1988, 1990, 1995, and 2000. The flow net analysis indicated that flow of ground-water from Mississippi to the Memphis area in the Memphis Sand aquifer was approximately 36.5 mgd in 1980, 39.8 mgd in 1988, 1990, and 1995, 43.2 mgd in 2000, and 33 mgd in 2005.

Ground-water flow modeling was also performed to supplement the flow net analyses for calculating ground-water flow contribution from Mississippi as a result of Memphis area pumpage. The modeling exercises were performed utilizing the USGS model prepared by Brahana and Broshears (2001). Flow amounts calculated from the model for 1980 was 33.5 mgd, for 1983 was 34.5 mgd, for 1991 was 35.6 mgd, for 1995 was 32.3 mgd, for 2000 was 33.2 mgd and for 2005 was 33.3 mgd. These quantities are in the same range of values reported by Moore in 1965, Criner in 1964, Feldman in 2000, Gentry in 2000 and Arthur in 2006. From the review of **Table 2** contained in this report, which shows the pumpage amounts in the model from various counties for each stress period, a significant increase in pumpage from DeSoto County can be observed after 1993. This corresponds with a decrease in the flow contribution from DeSoto County

to Shelby County calculated from the model. As a result, the increased pumpage in DeSoto County is preventing the increased pumpage from the Memphis area to capture some of the ground water from the northern Mississippi area.

Based upon the Brahana Model, our own independent flow net analysis, potentiometric surface mapping, ground-water modeling, and our review of studies by other reputable scientists and water policy analysts (as discussed herein), it is our opinion that (1) Memphis area pumpage, primarily by MLGW, has altered the natural flow path and created a cone of depression in the Memphis Sand aquifer, resulting in the diversion of Mississippi's ground water; and (2) over the period of 1965 to 2006, an estimated 25 % to 35 % of Memphis area water supply has been derived from Mississippi.

Since MLGW is by far the largest ground-water user in the Memphis area, it was decided that impacts from their ground-water pumpage should be evaluated. This was accomplished by utilizing the Brahana and Broshears (2001) model. The model was run utilizing historical pumpage from 1965 to 2006. The modeling results show a large cone of depression extending into northern Mississippi. **Table 4** lists the volumes derived from the modeling exercise for each year beginning in 1965 through 2006 that are diverted from Mississippi ground water as a result of MLGW pumpage. The ground-water budget analysis showed that currently approximately 24 mgd of Mississippi ground water is being diverted towards Memphis due to MLGW pumpage. The total volume of ground water diverted from Mississippi due to MLGW pumpage

since 1965 is calculated to be approximately 361.4 billion gallons.

It appears that this quantity will not change significantly in the future. Our evaluation also shows that 15 % to 22 % of MLGW's ground water withdrawals are obtained from ground water beneath Mississippi as shown in the table below.

Year	Percent Volume Diverted	Year	Percent Volume Diverted	Year	Percent Volume Diverted
1965	19	1979	20	1993	18
1966	20	1980	20	1994	18
1967	20	1981	20	1995	16
1968	20	1982	20	1996	16
1969	20	1983	19	1997	16
1970	21	1984	19	1998	16
1971	21	1985	19	1999	16
1972	22	1986	19	2000	15
1973	21	1987	19	2001	15
1974	21	1988	19	2002	15
1975	20	1989	19	2003	15
1976	20	1990	19	2004	15
1977	20	1991	18	2005	15
1978	20	1992	18	2006	15

It is our opinion that based on our analysis and the review of technical reports produced by others, ground-water pumpage from MLGW in the Memphis area has created a large cone of depression that has

altered natural aquifer flow paths, and as a result is capturing ground-water from beneath the state of Mississippi at a rate of approximately 24 mgd.

[See color figures and explanatory notes, next 8 pages]

FIGURE 30
1886 Estimated Potentiometric Surface Map for Predevelopment Conditions, with Explanatory Note [This document was excerpted from Figure No. 30 from Wiley's Report (USCA5 2414)]

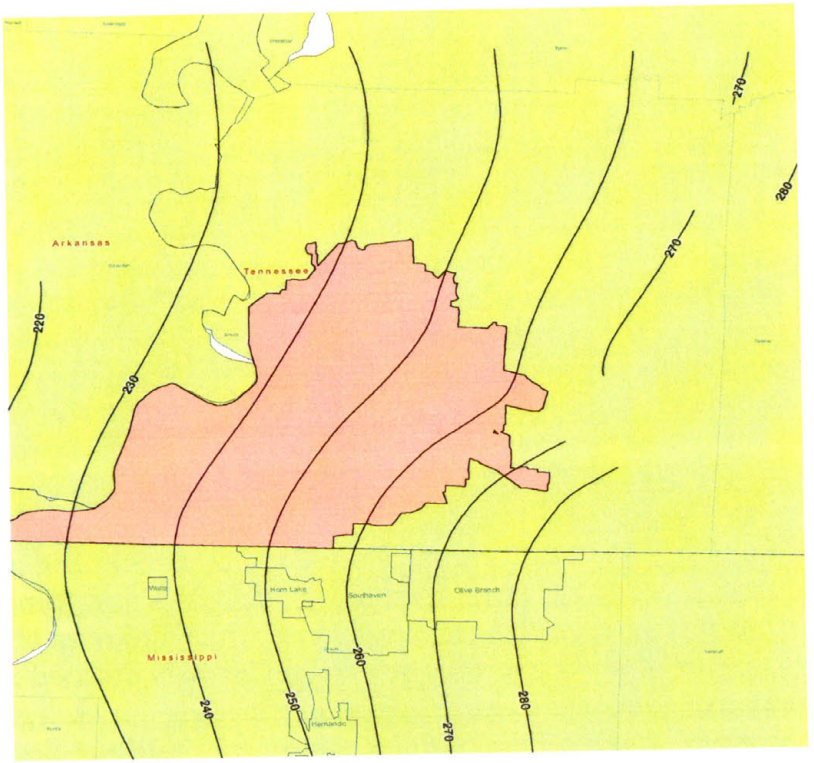
FIGURE 5
Three-Dimensional Illustration Showing Cone of Depression, with Explanatory Note [This document was excerpted from Figure No. 5 from Wiley's Report (USCA5 2389)]

FIGURE 3
Typical Cone of Depression Around a Well, with Explanatory Note [This document was excerpted from Figure No. 3 from Wiley's Report (USCA5 2387)]

FIGURE 23
Flow Net Based on USGS 1980 Potentiometric Surface Map, with Explanatory Note [This document was excerpted from Figure No. 23 from Wiley's Report (USCA5 2407)]

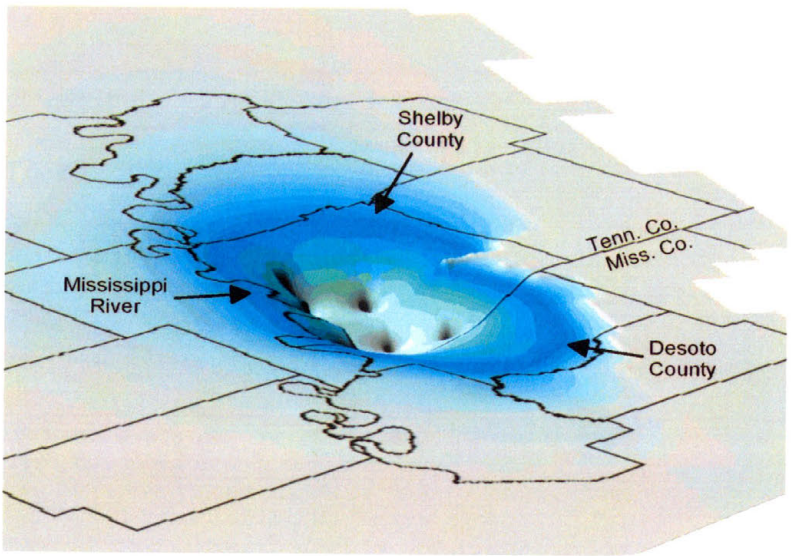
Explanatory Note: The figure to the right is a ground water flow model-computed potentiometric surface of the Memphis Sand or Sparta Aquifer prior to 1886, which is considered to represent pre-development or pre-pumping conditions. It shows that the pre-development ground water flow direction of the Aquifer was from east to west toward the Mississippi River. Potentiometric surface is the ground water level to which water in an aquifer will rise in a tightly cased water well. Potentiometric surface maps illustrate the ground water gradient across a given area. Potentiometric surface maps also provide information regarding ground-water gradient or flow direction which is always perpendicular to contours. In the figure, it is clear that there is no cone of depression under pre-development conditions. The ground water in the aquifer underlying northern Mississippi moved from east to west as may be demonstrated by flow lines drawn perpendicular to the depicted contours on the potentiometric surface map. None of the ground water involved in Mississippi's action would have ever naturally flowed into Tennessee.

[Explanatory Note Not Included In Original Report.]


Arkansas
Tennessee
Mississippi
Horn Lake
Southaven
Olive Branch
Hernando
220
230
240
250
260
270
280
270
270
280

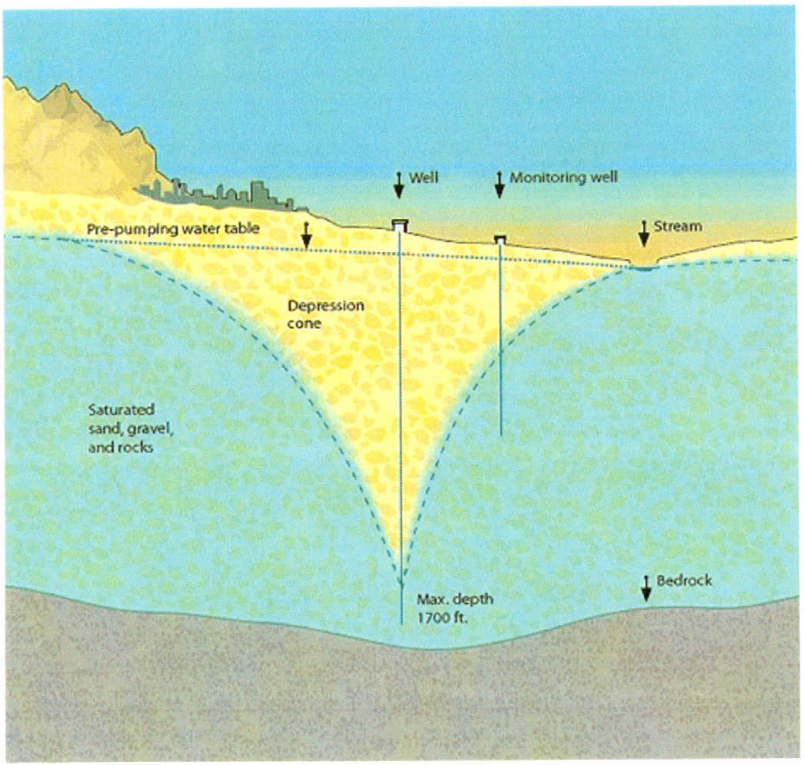
Explanatory Note: Commencing in 1886, MLGW's pumpage and withdrawal of aquifer groundwater disturbed its steady-state condition and created a dynamic flow condition, thus altering the aquifer ground-water system. These circumstances created the cone of depression under Memphis that expands deeply into Mississippi. A three-dimensional illustration of the cone would resemble the image shown to the right. In the pre-development steady-state condition of the aquifer, there was continual inflow (recharge) of water in the aquifer so that there was always a constant volume of water physically present under Mississippi, and more particularly Desoto County. The water levels of this constant volume have varied over time depending on stresses on the aquifer such as MLGW's pumping. There are a number of components that make up the aquifer water inventory or "budget"as it is defined in hydrogeological terms. These include recharge, changes in storage, ground-water in-flow and out-flow, and other factors. When a stress such as MLGW's pumpage is introduced to the system, it creates a cone of depression that gradually reaches out further and further to draw in more water to maintain the ground-water supply for MLGW's wells. The ground-water system in the Desoto County area was, prior to MLGW pumpage, in a steady-state condition.

[Explanatory Note Not Included In Original Report.]


Shelby
County
Tenn. Co.
Miss. Co.
Mississippi
River
Desoto
County

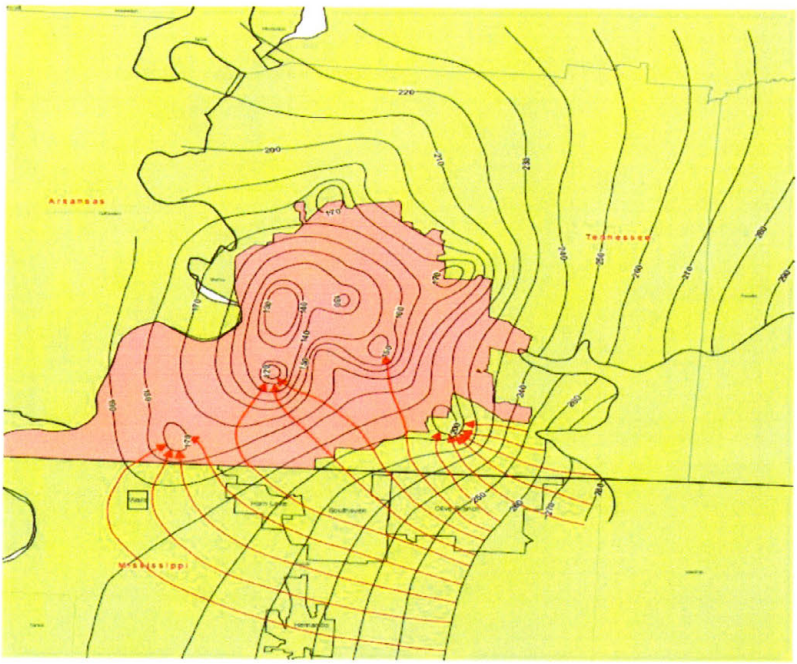
Explanatory Note: A cone of depression is a pattern that forms when a pumping well pumps from an aquifer, in this case a confined aquifer. When a large cone forms in a confined aquifer, the water levels decline due to pumping and there is an increase in hydraulic gradient which in turn alters and controls ground water velocity and direction of flow. The shape and extent or size of the cone depends on the rate and duration of pumping, and the hydraulic properties of the aquifer (groundwater system). It begins to form a funnel-shaped vortex in the potentiometric surface of the aquifer, as shown (for illustration purposes only) in the hydrogeologic cross-section to the right.

[Explanatory Note Not Included In Original Report.]

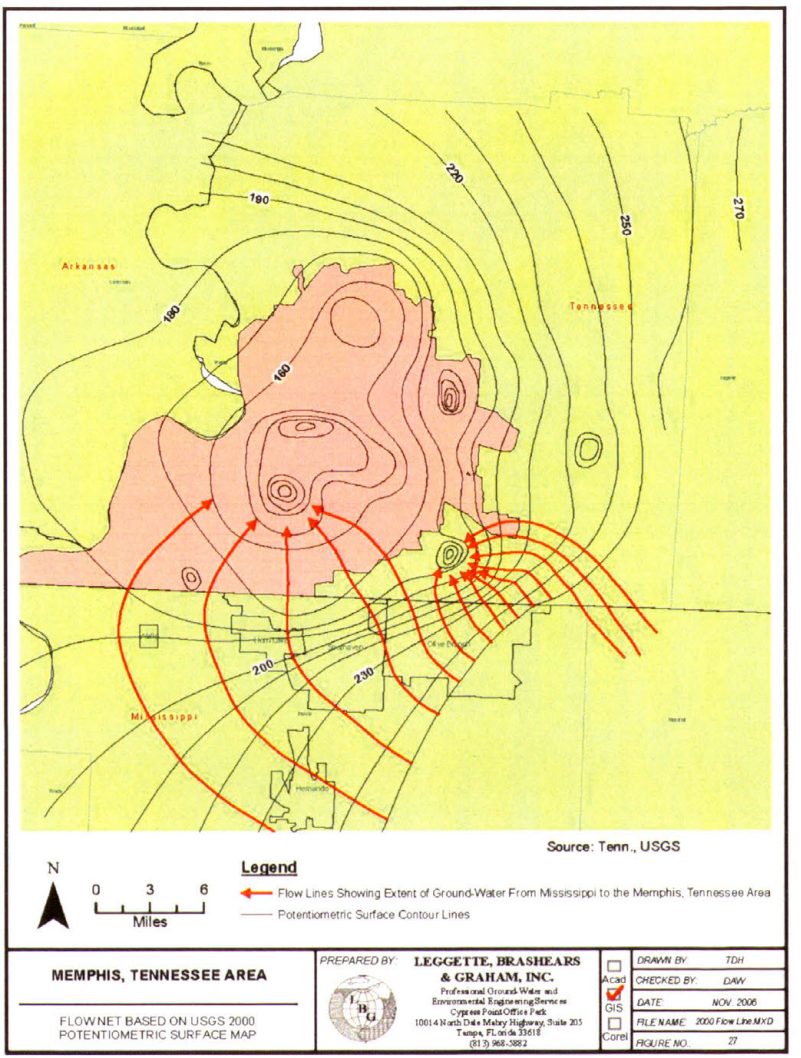

Well
Monitoring well
Stream
Pre-pumping water table
Depression cone
Saturated sand, gravel, and rocks
Max. depth 1700 ft.
Bedrock

Explanatory Note: MLGW's pumping operations have diverted the aquifer's ground water movement from its natural westerly direction to a true northward accelerated flow path toward the steepest part of the cone which underlies Memphis. As a result, MLGW's pumpage has been and is now capturing aquifer ground water beneath Mississippi. The illustration to the right demonstrates how MLGW's ground water pumpage has altered the natural flow gradient and rate, causing Mississippi's water to move northward. The curved lines on the illustration, called "potentiometric contours," depict the configuration and expansive geographic scope of the cone. The illustration is a "flow net," a graphical representation of the ground-water flow system consisting of a set of equipotential lines (i.e., the contour lines of the aquifer's potentiometric surface as defined by measured water levels) and corresponding flow lines. Flow net analysis is a standard hydrologic method used to calculate ground-water flow volumes, in this instance driven by the cone from within Mississippi northward into Memphis. Flow lines define the direction of ground-water movement resulting from the pumping stress imposed by MLGW on the aquifer beneath Mississippi. The red arrows, or "flow lines" on the flow net illustration to the right show how the cone causes Mississippi's aquifer ground water to actually change direction from its normal east to west course of movement as it is drawn into a true north pathway directly into the smaller contours representing MLGW's southernmost well fields.

[Explanatory Note Not Included In Original Report.]


Arkansas
Tennessee
Mississippi

[USCA5 2411]
Flow Net Based on USGS 2000 Potentiometric Surface Map



[See color figure and explanatory note, next 2 pages]

FIGURE 4
Cone of Depression (Drawdown Area) from MLGW Pumpage, with Explanatory Note [This document was excerpted from Figure No. 4 from Wiley's Report (USCA5 2388)]

Explanatory Note: Memphis and MLGW have never disputed either the existence of the huge cone caused by their pumping or its past and continuing effects on Mississippi's ground water resources. The cone results from cumulative ground water pumping from multiple wells in numerous well fields operated by MLGW for Memphis' municipal supply and sales. Essentially, many smaller individual well cones of depression overlap forming one, expansive cone of depression with broad geographical impact. The area of this large cone, occurring from MLGW's cumulative well field pumpage, is depicted in yellow on the graphic representation shown to the right. Due to demand and growth of MLGW's system, the aquifer has been pumped and drawn down at a higher rate than it is being recharged or replenished, causing water levels to drop and creating the cone of depression expanding outward from Memphis across the border into Desoto County, Mississippi.

[Explanatory Note Not Included In Original Report.]

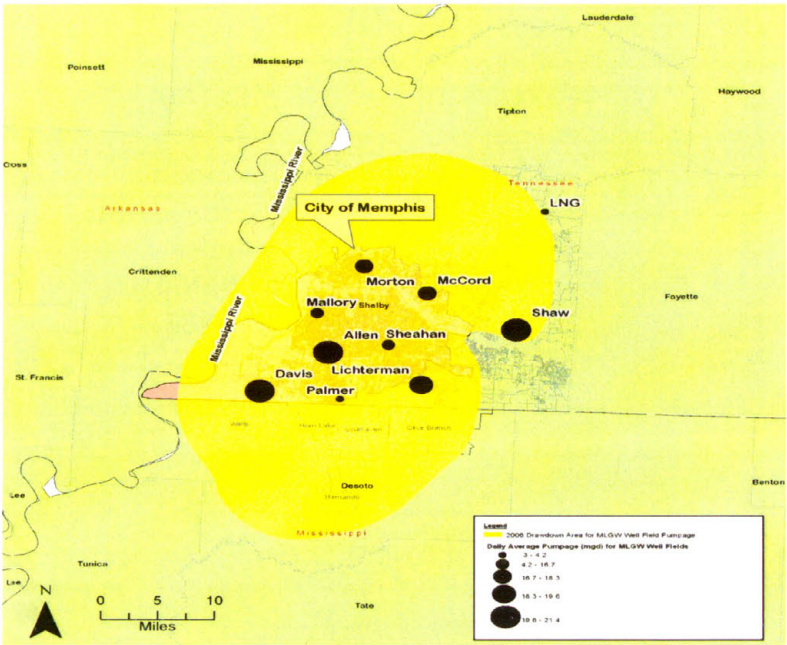

Lauderdale
Poinsett
Mississippi
Haywood
Tipton
Coss
Mississippi River
Tennessee
Arkansas
City of Memphis
LNG
Crittenden
Morton
McCord
Mallory
Shelby
Shaw
Foyette
Allen
Sheahan
Mississippi River
St. Francis
Davis
Lichterman
Palmer
Desoto
Benton
Lee
Mississippi
Tunica
Lee
Tate
N
0
5
10
Miles
Legend
2006 Drawdown Area for ML&W Well Field Pumpage
Daily Average Pumpage (mgd) for ML&W Well Fields
3 - 4.2
4.2 - 16.7
16.7 - 18.3
18.3 - 19.6
19.6 - 21.4

EXHIBIT 3

[USCA5 2152 - USCA5 2169]

Foster Economic Research
William G. Foster, Ph.D., President
1865 Mountainside Drive
Blacksburg, Virginia 24060
Telephone: (540) 552-2466

May 31, 2007

Jim Hood, Attorney General
State of Mississippi
Attention: Alan B. Cameron, Esq.
Daniel Coker Horton & Bell, P.A.
265 North Lamar Blvd.
Oxford, MS 38655-1396

Dear Alan:

Please find enclosed a copy of my updated and revised expert report prepared for the State of Mississippi in its litigation against the City of Memphis, Tennessee and Memphis Light, Gas & Water Division (Civil Action No.2:05CV0032, U.S. District Court for Northern Mississippi Delta Division). In addition to the text of the report you will find enclosed: Exhibit I, my resume; Exhibit II, a list of documents that I have reviewed or relied upon; and Exhibit III, schedules that support my findings.

Yours truly,

/s/ William G. Foster
William G. Foster, Ph.D.

Enclosure

IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF MISSISSIPPI DELTA DIVISION CIVIL ACTION NO.2:05CV0032

Expert Report (Update & Revisions)

By

William G. Foster, Ph.D.
for
The State of Mississippi

I. Introduction

I understand that this case concerns the unlawful taking, usage, and selling of the State of Mississippi's water resources by the city of Memphis, Tennessee, and Memphis Light, Gas & Water Division (MLGW). MLGW is a combination electric, gas, and water municipal utility serving the city of Memphis and Shelby County, Tennessee.

I have been requested by the State of Mississippi to:

A) Determine the fair value of the water resources in dispute for the period 1985 through 2006.

B) Determine the amount owed to Mississippi, plus interest, based on the fair market value for the referenced periods.

C) Conduct similar studies of the fair value of Mississippi water for the period 1965 through

1984, and prospectively from 2007 through 2016.

MLGW pumps high quality water from the Memphis Sands Aquifer. This aquifer extends into Northwest Mississippi. MLGW's pumpage has created and expanded a geophysical condition known as a "cone of depression", thereby affecting the aquifer such that Mississippi's ground water is, and has long been, diverted and taken by MLGW to supplement its water supply distribution system. (*See* David A. Wiley, P.G., Vice President, Leggette, Brashears & Graham, Inc., "Report on Diversion of Ground Water from Northern Mississippi Due to Memphis Area Well Fields" (May 2007)).

This is a revised and updated version of the report that I prepared in December 2006. At the time of my preliminary report, MLGW had not provided documents and data sufficient to address a number of specific points. However, as a result of materials disclosed by MLGW over the several months since the initial report, I am now able to supplement my prior investigation and opinions. The major changes in this report are as follows:

1) The Mississippi Engineering Group provided a cost estimate for a surface water treatment plant.

2) The drilling of new wells as an alternative source of water for MLGW has been evaluated by Leggett, Brashears & Graham.

3) The annual production costs based on MLGW's Financial Reports and raw pumpage information have been updated.

4) Raw pumpage information, as provided by Leggett, Brashears & Graham, has been substituted for the net pumpage to system data.

5) The fair value of Mississippi water for the period 1965 through 1984 has been assessed.

6) The value of the Memphis Sands Aquifer water to MLGW's customers has been revised based upon Dr. Wade's updated results.

7) MLGW's water rate comparison with peer cities has been updated to 2007, and expanded to include DeSoto County.

I am the President of Foster Economic Research. I have been an independent economic consultant in the natural resource field for more than 37 years, specializing in market analysis. I hold a Ph.D. in economics from The George Washington University. A copy of my resume is in Exhibit I of this report.

I am being compensated for the preparation of this report at a rate of $215 per hour.

I reserve the right to revise this report as necessary to reflect new facts that may become available. Exhibit II is a list of documents that I relied on in order to form my opinion. The rest of the report is organized, for the separate timeframes 1985-2006 and 1965-1984, as follows: fair market approach, market factors and

fair market value/damages. I also estimated prospective damages (2007-2016).

II. Executive Summary

I have been requested by the State of Mississippi to determine the value of the water resources in dispute between Mississippi and MLGW for the period 1965 through 2006, and prospectively through 2016. I have also been asked to determine the total amount owed to Mississippi, including interest, for the historical period.

The value of the water can be estimated using a market value determination. Had MLGW negotiated a wholesale purchase contract to buy the water from Mississippi, the two parties would have considered a number of factors, including: market demand, quality and location of the water, alternative sources of supply, cost of production, value to consumers, and comparable water rates.

The amount owed to Mississippi is the market price multiplied by the volumes taken by MLGW plus interest. Two market prices were estimated: one based upon MLGW's wholesale contract rates, and the other based upon MLGW's wholesale contract rates minus production costs. Based on these two market price scenarios, the total damages (including interest) for the period 1965 through 2006 range from $713 million to $973 million. On a prospective basis through 2016, MLGW is projected to owe Mississippi $134 million to $159 million.

III. Fair Market Approach

My approach in determining the fair value of Mississippi's ground water is a market value determination. MLGW could have approached Mississippi in order to contract for the purchase of water from Mississippi's portion of the Memphis Sands Aquifer. Instead, MLGW continued to pump Mississippi ground water without permission or payment. Mississippi should have been compensated for its water by means of a wholesale purchase contract. The market value of a wholesale water contract is the price that a buyer and a seller negotiate at a given time. The amount owed to Mississippi is the price multiplied by the volumes taken by MLGW plus interest.

In negotiating such a contract, a number of factors should be considered, including market demand, quality and location of the water, alternative sources of supply, cost of production, value to consumers, and comparable water rates. These factors will be discussed in turn.

IV. Market Factors (1985-2006)

A) Market Demand

In 1985, MLGW used approximately 54.3 million cubic feet (c. f.) of water. The system showed major growth over the previous twenty years as a result of population growth and new industry. The following table shows MLGW's water usage over the period 1965-1985.

Table 1
MLGW Water Usage 1965-1985
Millions of c. f.

Year	Res.	Com.	Free Met.	Other	Total
1965	13.0	14.6	1.3	.1	29.0
1970	16.0	19.0	1.5	.4	36.9
1975	20.3	22.0	1.0	1.1	44.4
1980	24.1	25.1	1.3	.8	51.3
1985	25.1	25.2	2.4	1.6	54.3
Gr. Rate	3.3%	2.8%	3.1%	----	3.2%

Source: MLGW Annual Reports

Between 1965 and 1985, water demand on MLGW's system grew in excess of 3% per year. From 1975-1985 water demand grew at 2% per year. MLGW's *1985 Annual Report* discusses the growth in the City of Memphis, and the importance of the quality of water drawn from the Memphis Sands Aquifer in attracting new industries to the area.

> *Memphis water is one of the city's key selling points when industries are contemplating locating in the city. Many industries that require a highly pure and abundant source of water for their products, such as brewing, bottling, or cosmetic manufacturing, find Memphis' water ideal. Our water is of excellent quality, contains no organic matter or harmful bacteria and has no odor or taste. As a result, industries find little need for extensive filtering and purification systems that would be required in other major cities.*

> *...Memphis and Shelby County's water supply comes from an area 500 feet below the city which is called the Memphis Aquifer. Our water is pumped from 143 artesian wells at nine water stations owned by MLGW.*
>
> *...Even though Memphis and Shelby County is growing every day in population, MLGW will be able to accomodate* [sic] *future water needs of the city. While water shortages may affect the growth of cities in the future, Memphis can progress with an abundant water supply.*
>
> (*Memphis Light, Gas and Water Division 1985 Annual Report*, p. 13)

MLGW expected water consumption to continue to grow on its system. According to the utility's 1985 Water System Master Plan, residential/commercial consumption was expected to increase by over two percent per year.

Water demand continued to grow after 1985, and MLGW continued to pump water from the Memphis Sands Aquifer to meet system requirements. Between 1985 and 2006, water usage on MLGW's system grew by 1.1 percent per year. According MLGW's *2006 Master Plan Report*, water demand is expected to continue to grow by about 1 percent per year over the next decade.

B) Quality And Location Of The Water

In a wholesale water agreement, the quality and location of the water are primary considerations.

The water from the Memphis Sands Aquifer is superior in quality, as attested to by the above quoted MLGW Annual Report. In fact, in the 1986 Annual Report, MLGW boasted about the water quality in Memphis, saying:

> *The secret's out on Memphis' water... the American Water Works Association (AWWA)... voted Memphis' drinking water the best in the United States.*
>
> *...There are virtually no traces of heavy metals such as lead, mercury, and arsenic, and the water has no traces of man-made compounds such as pesticides or solvents. The reason? Memphis "artesian" water is naturally filtered by the Sands and gravel through which it is pumped, meaning that it arrives at the purification and pumping facilities in a remarkably clean form. Since it is well water, it is never exposed to the "surface impurities" which are common problems where surface water supplies, such as lakes or rivers, are used.*
>
> (*Memphis Light, Gas and Water Division 1986 Annual Report*, p. 6)

The location of the Memphis Sands Aquifer is also of benefit to MLGW. The proximity of the water to Memphis and Shelby County allows MLGW to locate their well fields close to the growth centers, which keeps the cost of the distribution at a low level.

C) Alternative Sources of Supply

Another consideration in negotiating a wholesale water contract is what other sources of water are available, and the cost of each. A rational buyer would consider the alternatives and eliminate those that are too expensive. In this case, the buyer (MLGW) would not be willing to pay Mississippi more than the cost of comparable water supplies. There are two possible alternative sources of water in this case: Mississippi River water and drilling new wells.

The Mississippi River as a source has many disadvantages. The water is lower in quality due to pollutants (e.g., agricultural runoff) and sediment. In order to use water from the river, MLGW would have to make major capital investments. These would include: pumping stations, treatment plants, and transmission facilities to tie into the existing infrastructure. MLGW's Spring 2005 Water Scanner Team Report (Water Rights section) lists four disadvantages to using water from a surface water plant: increased cost, taste and odor complaints, infrastructure issues, and increased regulations from the state. In a 2003 *Water World* article, Dr. Jerry Anderson, the Director of the University of Memphis Ground Water Institute, compared the cost of Memphis Sands water to that of Mississippi River water:

> *"Water from these sands costs $15 per 10,000 gallons per month delivered to residential customers, less than half of the cost in many parts of the country and only a third as much as in areas where the water has to be highly treated. If Memphis drew its water from the*

Mississippi River rather than from artesian wells, the cost would easily be three times more than it is."

(Memphis Water Termed "Sweetest in the World", *Water World* November 1, 2003)

The Mississippi Engineering Group conducted a study to estimate the cost of using Mississippi River water as an alternative source of supply for MLGW. The cost estimate is as follows:

1) Total capital investment, including a water treatment plant, an intake station, and transmission mains, would be $607 million.

2) Incremental operating and maintenance production costs would be $23.1 million per year.

3) The plant capacity would be 165 MGD, with an output of 120 MGD.

If MLGW had to invest $607 million in a Mississippi River treatment plant, the annual carrying cost including interest and depreciation would be approximately $46 million per year. This annual cost plus the incremental operating and maintenance production costs of $23.1 million, equals $69 million per year. This annual amount plus MLGW's cost of service would result in water rates that would be almost double the current level.

The above costs are in today's dollars. Construction costs and operating and maintenance production costs were lower in 1985 than they are today. Interest rates

were higher, therefore carrying charges were higher. I have estimated MLGW's 1985 capital investment in a Mississippi River treatment plant based on "The Handy-Whitman Index of Public Utility Construction Costs (Cost Of Trends Water Utility Construction in the South Central Region). The 1985 investment would have been $354 million, and the annual carrying charge would have been $40 million. The incremental operating and maintenance production costs would have been $11 million, based on MLGW cost trends. The total cost in 1985 would have been $51 million, making this option very costly. This cost would not establish a ceiling price between a buyer and seller for Memphis Sands water for it was far higher than any reasonable negotiated price.

Some suggest that another alternative would be to drill wells in the northeast portion of the MLGW service territory or beyond. The feasibility of this alternative is highly questionable. Leggett, Brashears & Graham studied the feasibility of drilling new wells. Mr. David Wiley reported the following results of this study:

> *The ground-water model was utilized to evaluate alternative water supply development options for MLGW to minimize or eliminate the cone of depression from extending down into Mississippi as a result of MLGW pumpage. This modeling exercise began by moving the southernmost MLGW well fields (Davis, Palmer and Lichterman) located in the Memphis area up to the northern part of Shelby County. This new configuration showed very little change in the cone of depression in Mississippi. The model was run again moving the Allen and Sheahan well*

fields up to the north. Again, there was little change in the cone of depression in northern Mississippi. Based on these exercises, it became obvious that in order to minimize or eliminate the cone of depression in Mississippi, most of the MLGW well fields would need to be moved significant distances to the north outside of Shelby County, essentially requiring the design and construction of hundreds of new wells and many miles of pipelines. The cost would be enormous.

We also considered looking at the Fort Pillow aquifer that underlies the Memphis Sand aquifer. Based on modeling results observed from pumping the Memphis Sand, water-level effects were also observed to occur in the Fort Pillow aquifer. The Fort Pillow aquifer is reported to be somewhat less productive than the Memphis Sand aquifer and also extends into Mississippi. Therefore, using this aquifer would create the same issues that pumping of the Memphis Sand causes. So, the use of the Fort Pillow aquifer is really not an alternative that can be of much use.

Next, we decided to run the model by eliminating MLGW well fields, with the assumption that the ground-water pumpage would have too be replaced through the use of Mississippi River water. Initially, we eliminated the three southernmost well fields. That is, we turned the Davis, Palmer and Lichterman well fields off. This created a small reduction in the cone of depression in Mississippi. Therefore, we re-ran the model by turning off four more

MLGW well fields (Allen, Mallory, Sheahan and Shaw). The results of this run showed that the cone of depression was reduced to only a few feet across the state line into northern Mississippi. At this point, only three MLGW well fields remained for a total 36.16 mgd of the 156.25 mgd total well field pumpage in 2006. This is a reduction of approximately 77 % of the MLGW well field pumpage or 120.09 mgd. Therefore, 120 mgd would need to be replaced from the Mississippi River. This would also be a very costly alternative for replacing the ground-water withdrawals by MLGW.

Based on our analysis using the ground-water model to determine the amount of ground water derived from beneath Mississippi as a result of the MLGW well field pumpage that was estimated to occur in 2006, we calculated a quantity of approximately 24 mgd. One might ask: Why couldn't MLGW just replace the 24 mgd that is calculated to be derived from beneath Mississippi? Replacing only 24 mgd would not do much to the existing cone of depression. Remember, a cone of depression for a well or well fields induces ground-water flow radially from all directions. So the 24 mgd derived from Mississippi is only a fraction of the induced water that causes the formation of the cone of depression. In fact, the 2006 pumpage for the Palmer and Lichterman well fielllds together equal approximately 24 mgd and do very little to the existing cone of depression by shutting them down.

However, should MLGW and the State of Mississippi agree to it, the least cost alternative for replacing the ground-water derived from beneath Mississippi would be to simply pay a reasonable cost for the 24 mgd.

Given the results of the above study, it would be impractical to consider drilling new wells. Mr. Wiley states that the only feasible alternative for MLGW would be to use water from the Mississippi River. However, according to the study by Mississippi Engineering Group cited above, this alternative would be prohibitively expensive.

D) Cost Of Production

MLGW has production costs associated with using water from the Memphis Sands Aquifer. These expenses include electric power for pumping, and other operating and maintenance expenses. These production costs have increased since 1985, as shown on the following table.

Table 2
MLGW's Production Costs

Year	$/Th. Gals.
1985	0.1418
1990	0.1646
1995	0.1663
2000	0.1805
2005	0.2248

Source: MLGW's Financial Reports (Dec.) and Raw Pumpage Volumes

In negotiating a contract, parties could argue whether the production costs should be deducted. The deductibility of these costs depends on the negotiating strengths of the parties. I have developed two cases in this report: one with production costs removed and one with them included. (See below.)

E) Value to MLGW's Customers

Economists determine the value of a commodity by estimating the customer's "willingness to pay". Dr. William W. Wade conducted a study to determine the value of MLGW's water to its customers based on their demand curves (i.e., volumes demanded at various prices). He found that, in 1985, the value to customers ranged from $0.23 to $0.53 per thousand gallons. (See "Revisions and Additions to Valuation of Mississippi-Owned Groundwater Used in MLGW Service Area," Revised Expert Report of William W. Wade, Ph. D.)

F) Comparable Retail Water Rates

From 1985 to date, MLGW's customers have benefited from the availability and low cost of water from the Memphis Sands Aquifer. In 2003 for example, MLGW states in it Annual Report:

> *The reliability and low cost of our utility service... led to more than $1.38 billion in new and expanding business investments during 2003 and created almost 8,000 new jobs in our area.*
>
> *... Some new businesses say a major influence in their relocation or expansion in Memphis is the reliability and low cost of MLGW services and*

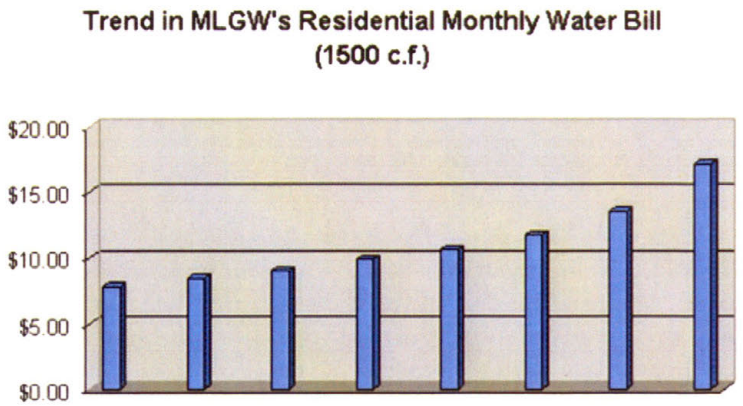
the abundant availability of naturally pure water in the area.

(*Memphis Light, Gas and Water Division 2003 Annual Report*, p. 9)

MLGW's rates are some of the lowest in the country. While they have increased over time, they are lower than the rates of peer cities. The table below and the chart on the following page show the trend in MLGW's residential rates and the average monthly bill for customers over the period May 1985 to December 2003. There have been no rate increases since December 30, 2003.

Table 3
Trend in MLGW's Residential
Water Rate(RS W-1)

Effective Date of Rate Change	$/Ccf	$/Th. Gal	$/Month (1500c.f./mo)
May 2 1985	$0.5250	$0.70	$7.88
Sept.1 1986	0.5618	$0.75	$8.43
March 1 1988	0.6011	$0.80	$9.02
Jan. 2 1990	0.6582	$0.88	$9.87
April 1 1991	0.7076	$0.95	$10.61
Jan 1 1993	0.7832	$1.05	$11.75
Jan 6 1995	0.9007	$1.20	$13.51
Dec 30 2003	1.1406	$1.52	$17.11



Today a MGLW residential customer pays about $17.11 per month for water. This is far less than customers in peer cities pay. I have collected rate information for peer cities during three years: 1997, 2001, and 2007. In every instance, MLGW's average water bill is less than that of other cities. For example, in 2007, while MLGW's customers were paying on average $17.11, the average for customers in peer cities was $29.12, 70 percent higher. Schedules 1, 2, and 3 of Exhibit III set out comparisons of average water bills during the above listed three years.

The following table shows that MLGW's water bills are also lower than the rates paid by residential customers in DeSoto County, Mississippi.

Table 4
Residential Water Bill Comparison 2007
(1,500 c.f.)

Memphis	**$17.11**
City of Southaven	$20.40
City of Hernando	$21.22
Horn Lake Water Ass'n	$29.56
City of Horn Lake	$29.61
City of Olive Branch	$31.41
North Miss Utility Co	$37.26
Belmont Water Ass'n	$38.67
Walls Water Ass'n	$39.67
Nesbit Water Ass'n	$40.17
Days Water Ass'n	$42.28
Lewisburg Water Ass'n	$44.67

The average monthly water bill for the eleven areas in DeSoto County is $34.08 per month, twice the average monthly bill in Memphis.

G) Wholesale Rates

In order to establish a fair market price for a commodity, one must examine comparable wholesale rates. In this case, one would normally investigate the price that Mississippi charges for its wholesale water contracts. Unfortunately, one cannot look to Mississippi contracts for water from the Memphis Sands Aquifer because Mississippi does not sell its water on the wholesale market. As a proxy, however, one can look to the wholesale prices that MLGW

charges for water from the Memphis Sands Aquifer. This resale rate represents the value that MLGW assigned to the water on the wholesale market.

The following table shows the trend in MLGW's wholesale market rates from 1985 to 2006.

Table 5
MLGW's Wholesale Market Rates

Effect. Date	$/C.c.f.	$/Th. Gals.
5/2/85	$0.4100	$0.548
9/1/86	$0.4390	$0.587
3/1/88	$0.4697	$0.628
1/2/90	$0.5143	$0.688
4/1/91	$0.5529	$0.739
1/1/93	$0.6171	$0.825
1/6/95	$0.7158	$0.957
12/30/03	$0.9881	$1.321

The above rates represent constant service. In other cases MLGW has negotiated contracts for peaking service. For example, in 2001 MLGW contracted with the City of Olive Branch, Mississippi to provide peaking service at a rate that ranged from 75% to 125% of the rate for constant wholesale service (W-9 rate).

V. Fair Market Value/Damages (1985-2006)

In my opinion, a fair market value is a rate between MLGW's wholesale rate and the wholesale rate minus production costs. I have developed two

damage cases, a high price case (wholesale rates) and a low price case (the wholesale rates minus production costs). The damages are the prices times the volume of the water unlawfully taken by MLGW over the period 1985 to 2006.

I have relied upon the Leggette, Brashears & Graham estimate of the volumes of water taken from Mississippi by MLGW. Schedule 4 of Exhibit III shows the volume of Mississippi's water that has been taken by MLGW from 1985 through 2006. In 1985, MLGW took 9,223.5 million gallons. This declined during the subsequent twenty years and was 8,846.9 million gallons in 2006. MLGW projects that pumpage will grow by about 1 percent per year; therefore MLGW must continue to pump increasing amounts from the Memphis Sands Aquifer to meet demands on its system.

I have applied the fair market value to these volumes to calculate the amount owed to Mississippi by MLGW. Schedules 5 and 6 of Exhibit III show the amount due under the high case and the low case. Schedules 7 and 8 show the calculation of the interest related to the high and low damage cases. Interest is applied at 8 percent compounded annually.

The table below summarizes the damages due to Mississippi plus interest over the period 1985 to 2006.

Table 6
Summary Of Damages 1985-2006

	High Case	Low Case
Principal	$176,752,970	$141,046,530
Interest @ 8%	$257,075,280	$198,975,020
Total	$433,828,250	$340,021,550

VI. Market Factors (1965-1984)

I have been requested to supplement my December 2006 report in order to assess the fair value of Mississippi ground water for the period 1965 through 1984. The market approach and the negotiating factors are the same as those that I relied upon for the period 1985 through 2006.

A) Market Demand

In 1965, MLGW used approximately 29.0 million cubic feet of water. The system grew by 3.8 percent per year between 1955 and 1965.

The Memphis Sands Aquifer was key to the city's population growth and its ability to attract new businesses. In 1965, MLGW stated in its Annual Report:

> *Memphians have a right to be proud of the quality and abundance of the water they drink and use. While other areas are harassed by shortages, Memphis' vast supply of pure, artesian water continues to attract industry to the city.*

(*Memphis Light, Gas and Water Division 1965 Annual Report*, p. 12)

B) Quality And Location Of The Water

Even prior to 1965, MLGW touted the benefits of the quality and location of water from the Memphis Sands Aquifer:

> *...the Water Division produces and distributes the highest quality of water to Memphis and contiguous area...Water pumped to the surface by strategically located wells is low in minerals and free from harmful bacteria.*
>
> (*Memphis Light, Gas and Water Division 1961 Annual Report*, pp. 15 & 16)

C) Alternative Sources of Supply

MLGW had the same potential alternative sources of supply during the 1965 through 1984 period as it did during the 1985 through 2006 period. The Mississippi River plant was the only feasible alternative, but it was far more expensive than negotiating a contract with Mississippi to purchase the high quality Memphis Sand water. In 1965, for example, the capital investment (adjusted for construction costs in 1965 dollars) in such a plant would have been $94 million, with a carrying charge of $6.4 million. The estimated incremental operating and maintenance would have been $2.2 million for a total of $8.6 million.

D) Cost of Production

Production costs were lower during this earlier period, in large part due to lower power costs. In 1965, the unit cost of production to pump raw water from the Memphis Sands Aquifer was $0.050 per thousand gallons. By 1984, the unit cost increased to $0.145 per thousand gallons. Just as in the case of the 1985 through 2006 period, I developed two fair values cases, one with production costs removed and one with them included.

E) Value to MLGW's Customers

Dr. Wade determined the value of the water to MLGW's customers by estimating their "willingness to pay". Dr. Wade measured this factor and found it to be a value between $0.15 and $0.34 per thousand gallons

F) Comparable Retail Water Rates

As with the later period, during the 1965 through 1984 period MLGW's water customers benefited from the availability of low cost water from the Memphis Sands Aquifer. Table 7 shows the trend in MLGW's residential water rates fro this period.

Table 7

Trend in MLGW's Residential Water Rate(RS W-1)

Effective Date	$/Ccf	$/Th. Gal	$/Month (1500c.f./mo)
Jan. 15, 1956	$0.287	$0.380	$4.30
Sept. 21, 1973	$0.330	$0.441	$4.95
March 3, 1976	$0.380	$0.508	$5.70
Nov. 25, 1981	$0.430	$0.575	$6.45

In 1977 MLGW in its Annual Report stated that:

> *MLGW's...rates continue to be competitive with other areas and a definite attraction to induce new business and industry to the area.*
>
> (*Memphis Light, Gas and Water Division 1977 Annual Report*, p. 2)

G) Wholesale Rates

As in the later period, I could not examine comparable wholesale rates charged under Mississippi contracts for water from the Memphis Sands Aquifer for the 1965 through 1984 period because Mississippi did not sell its water on the wholesale market. As a proxy however, one can look to the wholesale prices that MLGW charged for water from the Memphis

Sands Aquifer. This resale rate represents the value that MLGW assigned to the water on the wholesale market. Table 8 shows MLGW's wholesale market rates for the period.

Table 8
MLGW's Wholesale Market Rates

Effect. Date	$/C.c.f.	$/Th. Gals.
1/15/56	$0.165	$0.221
9/21/73	$0.210	$0.281
3/3/76	$0.270	$0.361
11/25/81	$0.330	$0.441

VII. Fair Market Value/Damages (1965-1984)

A fair market value is a rate between MLGW's wholesale rate and the wholesale rate minus production cost. I have developed two damage cases, a high price case (wholesale rates) and a low price case (the wholesale rates minus production cost). The damages are the prices times the volume of the water unlawfully taken by MLGW over the period 1965 to1984.

I have relied upon Leggette, Brashears & Graham's estimate of water taken from Mississippi by MLGW. Schedule 9 of Exhibit III shows the volume of Mississippi's water that was taken by MLGW from 1965 through 1984.

I have applied the fair market value to these volumes to calculate the amount owed to Mississippi

by MLGW for this period. Schedules 10 and 11 of Exhibit III show the amount due under the high case and the low case. Schedules 12 and 13 show the calculation of the interest related to the high and low damage cases. Interest is applied at 8 percent compounded annually.

The table below summarizes the damages due to Mississippi plus interest over the period 1965 to 1984.

Table 9
Summary Of Damages 1965-1984

	High Case	**Low Case**
Principal	$ 47,251,720	$ 34,625,610
Interest @ 8%	$491,994,340	$338,746,800
Total	$539,246,060	$373,372,410

The combined total damages (including interest) for the entire period (1965-2006) ranges from $713 million to $973 million.

VIII. Prospective Damages (2007-2016)

I have calculated prospective damages for the period 2007 through 2016. This estimate is based on the same methodology that was used above. The present value calculations assume that the total payment will be made in 2007, therefore the principal was discounted by eight percent. The prospective MLGW raw pumpage was increased by one percent per year, consistent with MLGW's 2006 Master Plan Report. The rate increases were taken from MLGW's Financial Scanner Team's Spring 2006 reports (see

page 13). Schedule 14 of Exhibit III shows the prospective damages. The table below summarizes the prospective damages.

Table 10
Summary Of Prospective Damages 2007-2016

	High Case	**Low Case**
Principal	$159,006,000	$133,781,000
Pres. Value @ 8%	$112,316,000	$ 94,569,000

EXHIBIT 4

[USCA5 2197 - USCA5 2203]

ENERGY & WATER ECONOMICS
39 Public Square, Suite 304
Columbia, TN 38401
Tel: (931) 490-0060
Fax: (931) 490-0057
E-mail: wade@energyandwatereconomics.com

January 2, 2007

VIA E-MAIL
Jim Hood, Attorney General
State of Mississippi
Attention: Alan B. Cameron, Esq.
Daniel Coker Horton & Bell, P.A.
E-mail: acameron@danielcoker.com

Re: Preliminary Expert Report: Valuation of Mississippi-Owned Groundwater Used in MLGW Service Area

Dear Alan:

I have completed my preliminary analysis for the State of Mississippi and I am pleased to submit the initial captioned report. Opinions expressed in the preliminary report are based upon information, documents and data currently available through discovery and other sources. As you know, we must receive further supplemental information from Memphis and MLGW in response to the long-outstanding requests made in discovery. Once I receive additional information, I intend to further

refine the valuation prepared for the State of Mississippi. It is my understanding that further information from Memphis and MLGW will need to be produced for Dr. Foster to complete his preliminary report dated December 15, 2006, as well.

Sincerely,

/s/ William W. Wade
William W. Wade, Ph.D.

December 29, 2006

IN THE UNITED STATES DISTRICT COURT FOR
THE NORTHERN DISTRICT OF MISSISSIPPI
DELTA DIVISION
CIVIL ACTION NO.2:05CV0032

Expert Report

Valuation of Mississippi-Owned Groundwater Used in MLGW Service Area

By

William W. Wade, Ph.D.

For

The State of Mississippi

Table of Contents

List of Tables and Figures

Valuation of Mississippi-Owned Groundwater Used in MLGW Service Area

William W. Wade, Ph. D.

Water is not a homogeneous commodity with a single source of value. Location, weather conditions, timing and quality, at least, figure into the valuation of water. Uses of the water matter to its value. Industrial uses and applications of water typically have higher economic values than both residential and irrigation uses. (Jenkins, Lund and Howitt, 2003; Wade, Hewitt and Nussbaum, 1991.)

The groundwater at issue is owned by the State of Mississippi. This analysis has been performed to determine the value of the groundwater taken by MLGW from the State of Mississippi and distributed to MLGW customers.

Two approaches can be used to value the State of Mississippi groundwater withdrawn by MLGW and provided as high quality potable water to MLGW customers.

1. The market value of the wholesale contract; i. e., the price that a willing buyer and a willing seller would negotiate.

2. The resource value of the water; i.e., the difference between MLGW's customers' maximum willingness to pay (WTP) for water and MLGW's actual retail rates.

Abundant literature supports each approach. I have been requested by the State of Mississippi to apply the

second approach to estimate the value of the Mississippi-owned water taken by MLGW, sold and used in its service area.

My work is ongoing and will be modified as additional information and new information become available or if I am asked by counsel to rebut opinions expressed in future reports or testimony of Defendants experts, or to respond to decisions of the Court.

I am a resource economist, Ph. D. University of Minnesota, 1973. I own the firm Energy and Water Economics. I specialize in issues related to environmental resources and water policy and have been working on supply, demand and valuation in watersheds across the United States since 1986. Beyond water policy, I have worked on energy economic and financial analyses within the utility and petroleum industries—upstream and downstream—for the past 30 years. My resume is attached as Exhibit C.

William W. Wade

Executive Summary

This report uses a standard resource economics method to estimate the value of the groundwater taken by Memphis Light, Gas and Water Division of the City of Memphis (MLGW) from the State of Mississippi for sale and distribution to, and use by, its customers. The State of Mississippi's losses of groundwater due to MLGW pumping are estimated for two periods: 1985 2006, based on MLGW records; projected, 2007 - 2016 based on MLGW's published sales forecasts.

State of Mississippi losses are valued based on MLGW published information about sales, pumpage, revenues, and unmetered and lost water together with my estimates of MLGW Residential and Commercial demand curves over the amounts of the water taken from Mississippi. (Industrial water use, largely self-supplied, is excluded from the valuation.) The annual amounts of Mississippi-owned groundwater taken by and sold in the MLGW service area is estimated by Leggette, Brashears & Graham. Their estimates show that MLGW pumpage of Mississippi groundwater has declined slightly over the last 20 years, from ~14 billion gallons annual average, 1985-1990, to ~12 billion gallons annual average, 2000 2005.

Table 1 shows the estimated total values for groundwater taken by MLGW from the State of Mississippi for the two periods. Estimated values are shown for the weighted average range of elasticity values for demand curves determined for Residential and Commercial customers served by MLGW. Section 5 describes the method and empirical basis for the values on Table 1. Elasticity values supporting the analysis have the effect of imparting a conservative

bias to the damage estimates. Interest and discount rates at 8 percent, compounded, are based on State of Mississippi's legal rate.

Table 1 Summary Damage Estimates with Interest at 8% Historic 1985 - 2006 Prospective 2007 - 2016		
	Low Elasticity -0.240	**High Elasticity -0.323**
Straight Historic Losses	$230,248,045	$152,740,663
Interest @ 8% Mississippi Statute rate	$360,664,679	$235,743,890
Total Historic Losses @ Year-end 2006	**$590,912,724**	**$388,484,553**
Prospective Losses Discounted to Year-end 2006 @ 8%	**$107,049,583**	**$72,132,104**

[USCA5 2271 - USCA5 2288]

May 31, 2007

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF
MISSISSIPPI DELTA DIVISION
CIVIL ACTION N0.2:05CV0032

Expert Report

Revisions & Additions to December 29, 2006 Report: Valuation of Mississippi-Owned Groundwater Used in MLGW Service Area

BY

William W. Wade, Ph.D.

For

The State of Mississippi

Contents

9 Losses back to 1965 are now included based an data provided since December 2006.

Appendix A: MLGW Annual Residential and Commercial Water Demand Models
Appendix B: William W. Wade Resume
Appendix C: Analytic Tables

I am a resource economist, Ph. D. University of Minnesota, 1973. I own the firm Energy and Water Economics. I specialize in issues related to environmental resources and water policy and have been working on supply, demand and valuation in watersheds across the United States since 1986. My work is ongoing and will be modified as additional information and new information become available or if I am asked by counsel to rebut opinions expressed in future reports or testimony of Defendant's experts, or to respond to decisions or questions of the Court. My resume is attached as Appendix B.

/s/ William W. Wade
William W. Wade

Revisions & Additions to December 29, 2006 Report:
Valuation of Mississippi-Owned Groundwater Used in MLGW Service Area
May 31, 2007
William W. Wade, Ph. D.

Executive Summary

This report revises calculations made in the December 2006 report to take account of data and information provided subsequently by MLGW. The objective remains to value the water in the Memphis Sands Aquifer underlying the State of Mississippi used in the MLGW service area. The water at issue is the State of Mississippi's property right. The water was taken by Memphis Light, Gas and Water Division of the City of Memphis (MLGW) from the State of Mississippi for sale and distribution to, and use by, its customers. MLGW did not pay for this water, but it has value based on the services it provides as consumed by residential, commercial and governmental users.

The value of water taken from the State of Mississippi is estimated based on the widely used approach described in the December report and summarized in this revised report. The December reported values have been revised based on data made available by MLGW since the December 2006 report was filed and based on revised hydrologic estimates by Leggette, Brashears & Graham.

More complete data and information provided within the MLGW monthly Financial reports made available since December allowed us to estimate demand curves for MLGW residential and commercial end users as the basis for MLGW-specific price elasticity values.

The values of the water taken from the State of Mississippi depend on the price elasticity of demand for the water. The extensive review of empirical research reported in the December report identified a range of estimates of price elasticity likely to apply to the MLGW service area. Data subsequently made available allowed us to estimate residential and commercial MLGW demand curves with excellent statistical properties. MLGW-specific price elasticity values related to these demand curves replace the values shown in the December report. The elasticity values taken from other studies reported in December are very close to the MLGW-specific elasticities estimated in this report.

I now estimate values of water from Mississippi over separate MLGW end use classes based on the MLGW-specific residential and commercial demand curves. The end use values are summed for each years estimate of values of water taken from State of Mississippi. Damages are estimated back to 1965 and forward to 2017. Table 1 (R) (for revised) summarizes the damages, which are discussed in this document. The range of damages is shown on the table.

Table 1(R) Summary Damage Estimates with Interest at 8%						
Historic 1965 – 2006 Prospective 2007 – 2016 $ Million (2006)						
	1965 - 2006			2007 - 2017		
	Low	**Expected**	**High**	**Low**	**Expected**	**High**
Residential	$58.8	$78.1	$117.0			
Commercial	$24.0	$37.6	$86.3			
Resale	$2.6	$3.6	$5.9			
G&M	$7.6	$7.6	$7.6			
Total	**$93.0**	**$127.0**	**$216.8**	**$40.4**	**$58.3**	**$104.9**
Interest/Discount @ statutory 8%	**$425.9**	**$585.3**	**$1,015.3**	**($13.9)**	**($20.1)**	**($36.2)**
Total Historic/Prospective Losses @ Year-end 2006	**$518.8**	**$712.3**	**$1,232.1**	**$26.4**	**$38.2**	**$68.6**

Source: EWE 052607

Based on the statistical properties of the underlying residential and commercial demand curves, the low and high values represent the 95% confidence interval; e.g., we can be 95 percent confident that the value of the historic damages falls between $93.0 and $217 million with the expected value of $127 million. Interest is computed at the State of Mississippi statutory rate of 8 percent.

Two possible alternative sources of water to replace Mississippi water have been considered: Mississippi River water and drilling new wells. Neither caps the damage estimates in this report. Mississippi Engineering Group conducted a study to estimate the cost of using Mississippi River water as an alternative source of supply for MLGW and concluded this to be an economically unfeasible option. ("Opinion of Probable Capital Cost and Production Operation and Maintenance Cost for the Conceptual Modifications to the MLWG Water System," May 2007.) Another alternative would be to drill wells in the northeast portion of the MLGW service territory or beyond. Leggett, Brashears & Graham studied the feasibility of drilling new wells and concluded that this alternative is equally unfeasible. (Report on Diversion of Ground Water from Northern Mississippi due to Memphis Area Fields, May 2007.)

1 Damage estimates for water taken by MLGW from the State of Mississippi are revised based on further data provided by MLGW.

The December 29 Expert Report, "Valuation of Mississippi-Owned Groundwater Used in MLGW Service Area," showed on Table 15 an estimate of damages, 1985 – 2002, based on three end uses as

understood at the time - Residential, Commercial and Other -- and compared the results to damages from the aggregate MLGW demand curve. In December, I only had end use sales and revenues from 1985 thru 2002. That comparison showed that although different end uses had demand curves with different price elasticities, the mean end use valuation estimates closely matched the damage estimate based on the aggregate demand curve. I reported the aggregate results as my estimate of damages at Table 14 because aggregate data were available through 2006. (2006 was an estimate; I now have 2006 data thru November, which I annualized by including December 2005.) The value of water taken for the period 1965 - 2006 shown on Table 1(R) above is lower than previously estimated because of hydrology revisions by Leggette, Brashears & Graham discussed below.

2 Corrections are made to end use classifications to disentangle "Other" uses reported by MLGW.

Another correction to my December report is facilitated by the data provided subsequent to December. The category "Other" that appears in selected MLGW reports is a mixture of metered sales, free water, and Fire Protection revenues. Data acquired and information processed since December 29, 2006, disentangle the reported category, "Other," into Resale (W-0931), Fire Protection (W-054 & -064), Government and Municipal (G&M) free water (W-0052), and Interdepartmental free water (W-0569). No water quantities are associated with Fire Protection and no revenues are associated with G&M. Consequently, the Other category reported on Table 11 in the December report mismatches dollars and quantities. Table 11(R) corrects the mismatch,

removing revenues for Fire Protection from the calculations altogether because no water quantities are attached to the stand-by sprinkler revenue class, and showing revenues for Resale separately.

Table 11(R) MLGW Average Customer Class Revenues 1985 2006

	$ Million	%
Residential	$24.43	54.3%
Commercial	$19.22	42.7%
G&M + Interdepartmental	$0.00	0.0%
Resale	$1.320	2.9%
Total	$44.97	100%

Source: MLGW December Financial Reports, each year.

3 Demand curves and price elasticities for the MLGW service area have been estimated with results that compare favorably to the values from the economic literature discussed in the December report.

Data provided by MLGW since December 2006 include MLGW sales and revenues by user class back to 1965. The 1965-2005 Memphis annual data were analyzed using OLS (ordinary least squares) regression demand models. Separate demand models were estimated for residential and commercial users. In both models, the dependent variable is total sales per connection annually in 1,000 gallons. The models explain very well demand growth and variability over the 41 year period for the two user classes. The models and results are discussed in Appendix A. Price elasticities obtained

from the models and used in the damage calculations are shown on Table 12A (R).

Table 12A (R) Price Elasticities

	Low	**Model**	High
Residential	-0.176	-0.236	-0.294
Commercial	-0.181	-0.341	-0.501
G&M + Interdepartmental	0.000	0.000	0.000
Resale	-0.177	-0.251	-0.325

Source: EWE 052607

The residential model price elasticity falls within the range of "low" and "mean" elasticities reported on Table 12A of the December report, -0.174 - -0.310. The 95% confidence interval on the price coefficient calculated from the Residential model, -0.176 to -0.294, falls nearly on top of the low to mean range adopted in December. This result confirms the reasonableness of the original research to identify the likely shape of the MLGW residential demand curve from other economic studies. More importantly, the elasticity values from prior work that examined dozens of water use demand studies confirm the reasonableness of these new findings.

Similarly, the commercial demand model yields a price elasticity, -0.341, virtually identical to that reported from the literature and shown on Table 12A of the December report, -0.344. No range of values was available from the literature cited in the December report. Table 12A (R) now shows the 95% confidence interval for the Commercial price elasticity to range from -0.181 to -0.501.

Resale elasticity remains the weighted average of Residential and Commercial sales in the area previously served by the Shelby County Water Distribution System.

4 New demand curves for MLGW residential and commercial customer classes are used in revised calculations of damages.

Research based on data provided since December allows three changes to the valuation method used earlier.

1 Damages can now be based on the value of water for each of the four end use categories. Instead of using the weighted average elasticities shown on Table 12B (R), the elasticity values calculated from our MLGW demand curves shown on Table 12A (R) are used and the results summed to each annual total value. The low and high values are the 95% confidence interval estimated values.

2 The weighted average MLGW aggregate price elasticity changes as shown on Table 12B (R) is based on the MLGW-specific elasticities. (Compare to table 12B in the December report, which shows low elasticity as -0.24 and mean elasticity as -0.323.) The Resale elasticity is calculated as the weighted average of County water sales revenue for rate classes W-051 & W-057, residential and commercial; [(0.851:0.149) * (-0.176:-0.181) = -0.177], for example. These aggregate price elasticity values are only used in the valuation of the prospective damages based on MLGW's forecast of aggregate sales and pumpage.

Table 12A (R) Price Elasticities			
	Low	Model	High
Residential	-0.176	-0.236	-0.294
Commercial	-0.181	-0.341	-0.501
G&M + Interdepartmental	0.000	0.000	0.000
Resale	-0.177	-0.251	-0.325
Total			

Source: EWE 052607

Table 12B (R) Weighted Price Elasticities		
Low	Model	High
-0.096	-0.128	-0.160
-0.077	-0.146	-0.214
0.000	0.000	0.000
-0.005	-0.007	-0.010
-0.178	**-0.281**	**-0.383**

3 G&M free water includes water provided to City of Memphis, Board of Education, Memphis Park Commission plus interdepartmental water. This water is provided under Article 65, Sec. 696, of the agreement between MLGW and City of Memphis. Per the Annual Free Water Report (Bates # MLGW 67191, for example, for 2005), the water is valued at the average Commercial rate.

5 A refresher about how the values of the water MLGW took from Mississippi are computed in light of the separate demand curves.

The objective is to value the water taken by MLGW from the Memphis Sands Aquifer underlying the State of Mississippi and used in MLGW's service area. MLGW did not pay for this water, but it has value based on the services it provides as consumed by residential, commercial and governmental users.

A standard resource economics method is used to estimate the value of the groundwater taken by Memphis Light, Gas and Water Division of the City of Memphis (MLGW) from the State of Mississippi for sale and distribution to, and use by, its customers. The value of water taken by MLGW from State of Mississippi is estimated based on the widely used approach described and cited in the December report. (Griffin, 2006; Young, 2005; McMahon, Wade & Roach, 2004; Jenkins, Lund, & Howitt, 2003.) A more recent study adopted the same approach to value residential water use in California while valuing business water use over individual sectors. (Nicholas Brozovie, David L. Sunding and David Zilberman, "Estimating business and residential water supply interruption

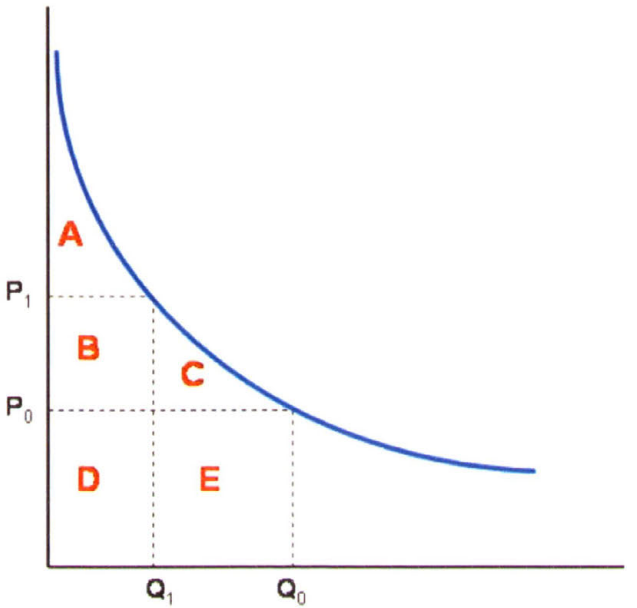
losses from catastrophic events," Working Paper, February 9, 2007.) Young provides the best summary of the algebraic mechanics at pages 256-259. Let me summarize graphically.

Human beings satisfy part of their needs ands wants by consuming goods and services that each individual demands to enhance his or her quality of life. Economists trace this relationship along demand curves such as the curvilinear downward sloping curve below. This demand curve reflects the fact that people will demand less of a good as its price increases and more as the price declines. How much is measured by the price elasticity of demand. Price elasticity measures how much more or less people will consume in relation to a price change. For instance, a price elasticity of -0.2 means that if price were to go up 10 percent, people would consume 2 percent less of the good.

Demand curves are sometimes referred to as willingness to pay curves because that is what they measure. Economists label the difference between willingness to pay observed from a demand curve and the goods market price as consumer surplus. This measure is used widely to value water in the resource economics literature and is the correct measure of value according to established economic theory.

Assume that MLGW sells water at price P_0 in the graph below. At this price, the quantity consumed is Q_0. Economists label the area (A+B+C) as consumer surplus. This is the amount consumers would be willing to pay above their actual payment (D+E) to consume Q_0. Consumer surplus is nothing more than a

measure of the income that people get to keep while consuming water at the level Q_0 in the example below.



Now, consider the value of the incremental unit of water from Q_1 to Q_0 that originates from State of Mississippi. The damage estimates begin by asking the question: What is the value to MLGW customers of the quantity of water between Q_1 and Q_0 that originates from Mississippi. This value is measured as the area under the curve between Q_1 and Q_0 the area equal to (C+E). This value includes the amount of revenue MLGW received (E) by selling the amount of water between Q_1 and Q_0 plus the consumer surplus MLGW customers received that can be attributed to access to Mississippi water (C).

While this is a correct answer to the question, it is not the value of the Mississippi water *in situ*. The revenues represented by (E) are matched to MLGW's

cost of service for the water taken from Mississippi. Consequently, the value represented by (E) is subtracted from the result. The value of the Mississippi water *in situ* is equal to the small triangle, (C).

Using a common demand specification described in the December report, the following formula is used to calculate the annual value (WTP_{it}) of the quantity of water between Q_{1it} and Q_{0it} for each end use, i = Residential, Commercial & Resale:

$$WTP_{it} = [\ (b^{-1/e}) / ((1/e)+1)\ ] * [\ Q_{0it}^{(1/e)+1} - Q_{1it}^{(1/e)+1}\ ] - [P_{0it} * (Q_{0it} - Q_{1it})]$$

This formula correctly estimates area (C+E) in the first bracket and then subtracts (E) in the second bracket. The value of the Mississippi water taken by MLGW is correctly measured as the gain in consumer surplus that accrues to MLGW residential customers plus the gain in producer surplus that accrues to commercial customers. The annual results are converted to pumped water and summed over the time periods. Appendix C tables show the details.

The theory behind the commercial valuation is similar. Instead of consumer surplus, we measure producer surplus, which is the difference between the supply cost of the input, water in this case, and the commercial demand.

MLGW sells all the water a commercial customer wants at Po*. So, the supply of water is horizontal. If a quantity of water Q_0 - Q_1 arises from the State of Mississippi, then the same triangle C represents the incremental value of that water to the firm above the cost of the water. Thus, in effect, producer surplus is measured in the same way as consumer surplus. Summed across all Commercial sales, it represents the value of the water for those end users.

Comparing the equation to the diagram, two ways were described in the December report to estimate the value of the water taken from Mississippi coupled with the demand curve:

1. Linear approximation using geometry depicted in the figure at the top;
2. Lost consumer surplus using the equation above.

The value calculated by the equation is approximately equal to (but less than) than the value of rectangle (E) plus the triangle (C), less the rectangle.

Instead of applying this approach over the aggregate MLGW demand curve as done in December, I now apply the approach separately over the residential, commercial and resale quantities of water. The G&M plus Interdepartmental water taken from Mississippi

---

* Actually, MLGW has a declining block rate structure. I assume that the rate structure is designed to set apart customers by size of water purchases. The marginal cost curve (supply curve) for water is stair-cased down, but flat over the range of each block.

is valued at the commercial average price for each year.

6 Raw water pumpage replaces net to system reported values.

The December report was based on MLGW reported net water pumpage to the MLGW system. This amount of water is less than the raw water pumped from the aquifer system. Damage estimates are now linked to raw water pumpage shown on the following table.

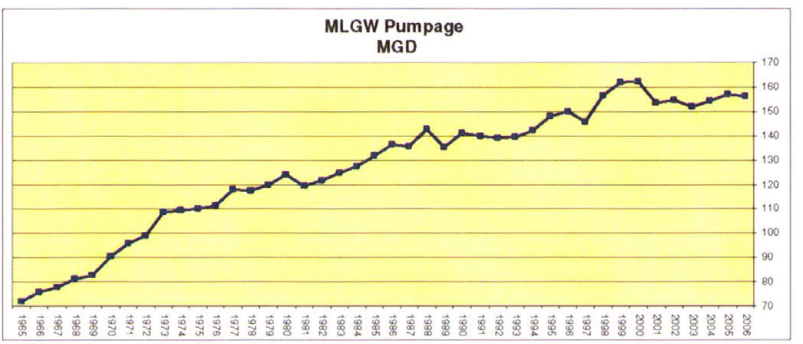
MLGW Raw Water Pumpage 1985 - 2006

Year	Raw Water MGD	Raw Water 1000 Gallons
2006	156.23	57,025,167
2005	156.89	57,265,458
2004	154.35	56,492,100
2003	151.90	55,443,804
2002	154.52	56,401,017
2001	153.41	55,993,700
2000	162.11	59,331,708
1999	161.88	59,084,900
1998	156.40	57,087,100
1997	145.67	53,170,600
1996	149.88	54,856,581
1995	148.00	54,020,000
1994	142.36	51,962,300
1993	139.62	50,959,900

1992	139.24	50,962,943
1991	140.07	51,125,900
1990	141.01	51,468,000
1989	135.32	49,393,500
1988	142.59	52,187,689
1987	135.45	49,437,900
1986	136.54	49,836,900
1985	131.66	48,054,175

Source: Leggette, Brashears & Graham, May 2007

The following figure plots MLGW raw water pumpage 1965 2006.



Source: Leggette, Brashears & Graham, May 2007

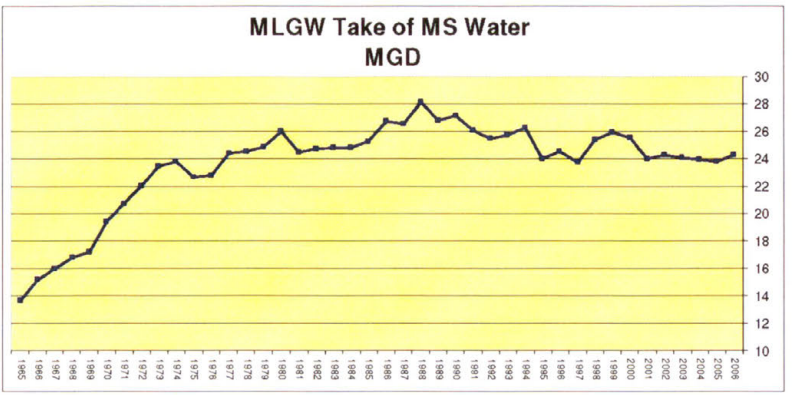
Increasing the amount of pumpage increases the amount of water taken from State of Mississippi, everything else equal. Table 13(R)A replaces Table 13 in the December report.

Table 13 (R) A Estimated MLGW Water Pumpage Taken from Mississippi 1985 - 2006

Year	MGD	1000 Gallons
2006	24.24	8,846,845
2005	23.77	8,676,576
2004	23.94	8,761,379
2003	24.06	8,783,172
2002	24.30	8,868,341
2001	23.98	8,751,512
2000	25.55	9,352,387
1999	25.90	9,453,978
1998	25.41	9,274,248
1997	23.72	8,659,374
1996	24.54	8,979,833
1995	24.03	8,769,163
1994	26.27	9,590,198
1993	25.73	9,391,191
1992	25.49	9,327,633
1991	26.04	9,505,723
1990	27.12	9,899,969
1989	26.80	9,782,466
1988	28.17	10,308,868
1987	26.56	9,694,885
1986	26.75	9,763,672
1985	25.27	9,223,484

Source: Leggette, Brashears & Graham, May 2007

The following figure plots MLGW take from the State of Mississippi, 1965 - 2006.



Source: Leggette, Brashears & Graham, May 2007

7 Revised 1985 - 2006 damages are lower due to reduced estimates of MLGW pumpage of State of Mississippi Groundwater.

Tables 14 A & B (R) below replace the original estimates. G&M is valued as average commercial price in each year times the amount of G&M water calculated as arising from Mississippi. Table 14C, based on model demand curves for MLGW service area, is considered the guiding damage estimate.

Table 14 A (R) Damage Estimates 1985 – 2006 High Price Elasticity		
	High Elasticity	Separate Demand Curves
Residential	-0.294	$41,649,289
Commercial	-0.501	$17,539,818
Resale	-0.325	$2,168,707
G&M	0	$5,478,502
Total		$66,836,316
Interest @ 8%		$92,955,308
Total		$159,791,624

Source: EWE 052607

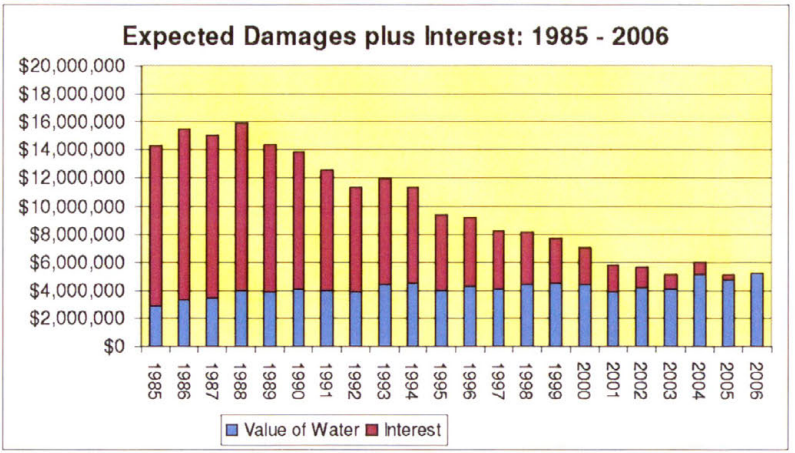
Table 14 B (R) Damage Estimates 1985 – 2006 Low Price Elasticity		
Thru 2006	Low Elasticity	Separate Demand Curves
Residential	-0.176	$81,868,663
Commercial	-0.181	$62,099,568
Resale	-0.177	$4,830,021
G&M	0	$5,478,502
Total		$154,276,753
Interest @ 8%		$218,651,845
Total		$372,928,599

Table 14 C Damage Estimates 1985 - 2006 Model Price Elasticity		
Thru 2006	Model Elasticity	Separate Demand Curves
Residential	-0.236	$55,151,419
Commercial	-0.341	$27,435,731
Resale	-0.251	$2,993,656
G&M	0	$5,478,502
Total		$91,059,308
Interest @ 8%		$127,415,243
Total		$218,474,551

Source: EWE 052607

Keep in mind that the values of water reported as damages arise mostly from household and commercial connections in the MLGW service area. The estimated annual average value of the residential water over the 1985 – 2006 period is $10.32. The average value of the commercial water over the period is $55.80. Average commercial water use per connections is 1,172,000 gallons compared to 82,000 for residentials. These values are based on the model result with an implicit confidence interval.

The figure below illustrates the annual damage estimates plus interest for the data behind Table 14C. Interested is compounded at the State of Mississippi statutory rate of 8 percent to yearend 2006.



source: EWE 052607

The December report mistakenly claimed that only 1 percent of MLGW water sales revenue arose from Industrial water users. Information made available and processed since that time reveals that approximately 6 percent of MLGW sales revenues arise from approximately 65 large Industrial water customers. (MLGW December Financial Reports, Annually) The value of water as a factor of industrial production varies across plants and industries. Research from California suggests that industrial values of water tend to be higher than values estimated in this study for Commercial water use.* In place of extensive studies of the 65 large water users, including their quantities and revenues in the

* Producer surplus values for commercial water estimated in the current research amount to approx. $150 per acre foot for 2006, which is substantially lower than values consistent with the authors 1991 industrial water use research.

Commercial Class imparts a conservative bias to the value estimates.

8 Future losses to 2017 are estimated based on revised hydrology and new model results.

Future losses are forecast to 2017 in the same manner as reported in the December report. MLGW forecast of net pumpage to the system is factored to convert to raw pumpage. Sales by end use have not been discovered. Hence, it is conservative (requires fewer assumptions) to rely on the MLGW existing forecast and estimate damages keyed to aggregate sales. Price elasticities from the model are adjusted based on Table 12B (R). The weighted average expected elasticity is -0.281. The range of damages based on the 95% confidence interval weighted elasticity values is shown on the table. The estimates hold MLGW efficiency constant at 81.49% and hold constant the amount of water taken from Mississippi at 15.5%, which was the 2006 value.

Table 16 (R) Damage Estimates with Discount Rate of 8% 2007 – 2016

	Low	Expected	High
Straight Losses	**$40,387,046**	**$58,308,975**	**$104,868,056**
Discounted to Year end 2006 @ 8%	**$26,445,625**	**$38,177,335**	**$68,646,063**

Source: EWE 052607

9 Losses back to 1965 are now included based on data provided since December 2006.

Customer classes are slightly different proportions of sales in the earlier period, 1965 -1984.

Table 11 B MLGW Average Customer Class Revenues 1965 - 1984		
	$ Million	%
Residential	$6.99	57.0%
Commercial	$5.04	41.1%
G&M + Free metered + Interdept		0.0%
Resale	$0.24	1.9%
Total	$12.26	100%

Source: MLGW December Financial Reports, each year.

Pumpage for the earlier period is shown on the following table.

MLGW Raw Water Pumpage 1965 - 1984		
Year	Raw Water MGD	Foster Raw Pumpage 1000 Gallons
1984	127.7	46,731,240
1983	124.9	45,572,434
1982	121.6	44,393,855
1981	119.4	43,583,920
1980	124.0	45,377,778
1979	119.7	43,695,610
1978	117.5	42,879,470

1977	118.0	43,074,380
1976	111.3	40,719,330
1975	110.2	40,218,375
1974	109.5	39,983,256
1973	108.5	39,591,549
1972	99.0	36,249,372
1971	95.9	34,988,170
1970	90.3	32,959,135
1969	82.6	30,165,425
1968	81.1	29,675,646
1967	77.7	28,361,230
1966	75.7	27,647,655
1965	72.0	26,265,765

Source: Leggette, Brashears & Graham, May 2007.

Water taken from Mississippi as estimated for the earlier period by the hydrologists is shown on Table 13 B.

Table 13 B Mississippi Water Taken by MLGW 1965 to 1984

	Water Taken from MS	Water Taken from MS
Year	MGD	1000 Gallons
1984	24.79	9,073,711
1983	24.79	9,048,097
1982	24.76	9,035,587
1981	24.49	8,937,977
1980	26.03	9,526,425
1979	24.88	9,080,089
1978	24.51	8,946,781
1977	24.42	8,912,360

1976	22.82	8,351,292
1975	22.68	8,279,508
1974	23.80	8,686,253
1973	23.45	8,560,292
1972	21.98	8,044,566
1971	20.71	7,559,910
1970	19.40	7,082,376
1969	17.22	6,286,102
1968	16.77	6,139,106
1967	16.00	5,840,500
1966	15.22	5,555,146
1965	13.70	4,999,832

Source: Leggette, Brashears & Graham, May 2007

Damage estimates are revised based on end user classifications and elasticities shown on Table 12A(R) above. Table 17C shows the estimates based on the estimated MLGW demand models. The value is bracketed by the estimates shown on Tables 17 A & B (R) based on the 95 % confidence intervals.

Table 17A (R) Damage Estimates 1965 – 1984 Model Price Elasticity

	Mean Elasticity	Separate Demand Curves
Residential	-0.294	$17,144,408
Commercial	-0.501	$6,425,509
Resale	-0.325	$447,782
G&M		$2,114,747
Total		$26,132,446
Interest @ 8%		$332,918,035
Total		$359,050,481

Source: EWE 052307

Table 17B (R) Damage Estimates 1965 – 1984 Low Price Elasticity		
	Low Elasticity	Separate Demand Curves
Residential	-0.176	$35,180,628
Commercial	-0.181	$24,220,962
Resale	-0.177	$1,035,112
G&M		$2,114,747
Total		$62,551,449
Interest @ 8%		$796,649,512
Total		$859,200,961

Table 17C Damage Estimates 1965 – 1984 Model Price Elasticity		
	EWE Elasticity	Separate Demand Curves
Residential	-0.236	$22,984,542
Commercial	-0.341	$10,206,418
Resale	-0.251	$626,730
G&M		$2,114,747
Total		$35,932,438
Interest @ 8%		$457,874,575
Total		$493,807,013

Source: EWE 052307

Keep in mind that the values of water reported as damages arise from household and commercial connections in the MLGW service area. The estimated annual average value of the residential water over the 1965 - 1984 period is $7.09. The average value of the commercial water over the period is $30.54. Average commercial water use per connections is 939,000

gallons compared to 90,000 for residentials. These values are based on the model result with an implicit confidence interval.

EXHIBIT 5

[RWG 000311]

Tom Charlier, "Memphis Taps Into DeSoto County's Well Levels," *The Commercial Appeal* (Monday, November 16, 1998)

[fold-out exhibit, see next page]

THE COMMERCIAL APPEAL

159th Year, No. 320, 4 Sections | Memphis, Tennessee, Monday, November 16, 1998 | FINAL 50¢

2 Dr. Gentry

USCA5 1990

Memphis taps into DeSoto County's well levels

By Tom Charlier
The Commercial Appeal

In getting their public water supplies, Memphis and neighboring communities in Mississippi are like a group of people drinking out of the same glass at a soda fountain.

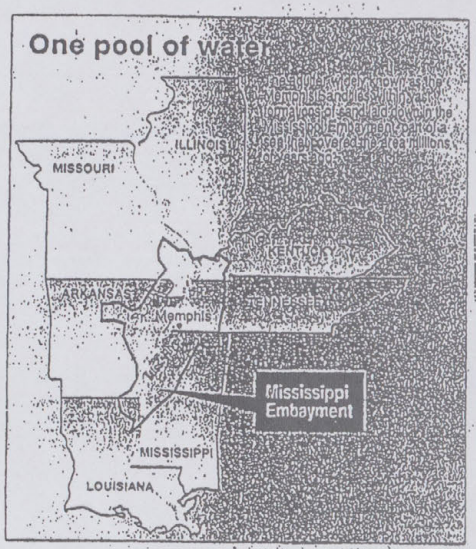
Only Memphis has the bigger straw.

In fact, though its wells lie entirely in Tennessee, the Bluff City is the largest user of Mississippi's ground water, according to that state's regulators. Memphis each day sucks 20 million to 40 million gallons from under the feet of its neighbors in DeSoto County, where wells already are straining to meet demand from rapid growth.

At a time when conflicts over surface water are escalating across other parts of Tennessee and the Southeast, the Memphis-area withdrawals show that ground water, too, can become an interstate issue.

"It's all the same pool of water," said John W. Smith, former director of the Ground Water Institute at the University of Memphis.

With that in mind, many regulators and researchers are calling for a more regional look at the aquifer system supplying the Memphis area. It's an indication that the deep, rich beds of saturated sands on which the area depends are perhaps more complex, interconnected and vulnerable than previously thought.



By Deborah D. Young

The issue of the cross-state withdrawals has taken on new significance in the wake of a recent meeting in which Mississippi regulators warned DeSoto County officials about the potential consequences of declining water levels.

Charles Branch, head of the office of land and water resources with the Mississippi Department of Environmental Quality, said his agency has turned more of its attention to the DeSoto County ground water issue in recent years.

"There's a lot of concern about the cumulative use in the Memphis area," Branch said.

"They (the city) are the largest user of ground water from the state of Mississippi. Significant volumes are flowing from DeSoto County northward into their pumping centers."

DeSoto County is hardly the only part of Mississippi dependent on ground water.

According to the U.S. Geological Survey, Mississippians use some 3.3 billion gallons of water a day, with 80 percent, or 2.6 billion gallons, coming from underground sources. Much of that water is used for irrigating crops or in catfish-farming operations, which soak up 400 million gallons a day.

In DeSoto County, soaring demands for water have been

Please see WATER, Page A9

From Page A1

Water

driven mostly by rapid development in Memphis suburbs. As in Memphis, public water is drawn from an aquifer widely known as the Memphis Sand.

DeSoto County well water levels have been declining at rates of a foot or more a year, though similar drops have been recorded in some Memphis Light, Gas & Water Division well fields.

Mississippi officials acknowledge that DeSoto's growth is responsible for much of the decline. And they say the well levels don't necessarily portend disaster.

But with Memphis siphoning away tens of millions of gallons daily, a comprehensive study is needed to ensure that all users will have enough water in the future, Branch said.

He urges the development of a three-dimensional computer model showing how water flows within the aquifer and how growth and increased pumping could affect it.

The aquifer is among the sand formations laid down across the bottom of the Mississippi Embayment, part of a sea that covered the area 60 million years ago. The embayment stretches from southeastern Missouri to Louisiana and from central Arkansas to near the Tennessee River.

In the Memphis area, the layer of saturated sands comprising the aquifer is up to 900 feet thick and lies 500 or so feet below ground. Further south, the Memphis Sand splits into what is known as the Sparta Sand, an aquifer that extends across North Mississippi and even dips under the Mississippi River into Arkansas.

Mississippi officials acknowledge that DeSoto's growth is responsible for much of the decline. And they say the well levels don't necessarily portend disaster.

"The formation we call the Memphis Sand occurs throughout the Mississippi Embayment," said Mike Bradley, assistant district chief for the USGS in Nashville.

In West Tennessee and North Mississippi, the natural flow of water in the aquifer is to the west and southwest, said Kerry Arthur, hydrologist and civil engineer with the USGS in Pearl, Miss. But the heavy pumping of municipal wells in Memphis, he said, has diverted that flow, creating "cones of depression" that pull water from the south.

Three of the well fields serving LG&W's 10 water-pumping stations extend to within 2½ miles of the Mississippi line.

Arthur said preliminary analyses suggest that as much as 20 percent to 30 percent of the water pumped by LG&W could be coming from Mississippi. The Memphis utility pumps about 145 million gallons daily.

Smith, who, as institute director, led studies on behalf of LG&W, said there's no dispute that some of that water comes from Mississippi.

"As we've increased our pumping rates, we've forced more water to come north from Mississippi into Shelby County," Smith said.

But while the aquifer crosses state lines, studies of it generally have not.

"As a regional resource, the Memphis Sand in Tennessee has been studied since the 1920s," said Bradley.

Interstate studies haven't been as common in the water-rich East as they are in the West, where "they divide up almost every raindrop," Bradley said.

More recently, studies have centered on Shelby County and concerns about contamination. The worries helped inspire the formation a decade ago of the city-county Groundwater Quality Control Board, a group charged with protecting aquifers.

Representatives of the board said they welcome more regional involvement in overseeing the aquifer.

"If you're trying to protect a resource that has as its boundaries a multistate area, then you need the cooperation to protect all that resource," said Carter Gray, technical secretary for the board.

Gray said cooperation across state lines also could help identify contamination threats to the aquifer, such as polluting industries, that might plan on locating in DeSoto or neighboring counties.

Smith said the involvement of Mississippi officials in monitoring the aquifer could bring about better water management in DeSoto County.

"DeSoto County doesn't have an (LG&W). They have 10 to 20 individual water utilities," Smith said.

It's important, Branch said, for all the groups having a stake in the aquifer to participate in efforts to protect it.

"Whatever happens in one area affects people in another" he said. "We need to have a more in-depth understanding of how this system works."

It's obvious, Branch said, that pumping ever more water from the ground eventually could cause shortages.

"There will come a time that you'll have more pronounced effects on these water levels, not just in DeSoto County, but in Shelby County."

EXHIBIT 6

[USCA5 1992 - USCA5 2000]

FINAL REPORT

WATER SUPPLY CHALLENGES FACING TENNESSEE: CASE STUDY ANALYSES AND THE NEED FOR LONG-TERM PLANNING

by

David Lewis Feldman, Ph.D.
Principal Investigator and
Senior Research Scientist,
Energy, Environment and Resources Center,
The University of Tennessee-Knoxville

Julia O. Elmendorf, J.D.
College of Law and Energy, Environment
and Resources Center,
The University of Tennessee-Knoxville

Prepared for the Environmental Policy Office,
Tennessee Department of Environment
and Conservation, Nashville, Tennessee

Produced by the Energy, Environment
and Resources Center
The University of Tennessee-Knoxville
311 Conference Center Building
Knoxville, TN 37996-4134
Phone (865) 974-4251

June, 2000

TABLE OF CONTENTS

* * *

[p.54] evaluated at the *lowest* flow, not at times of abundant flow. In past drought years, navigation on the Mississippi has been halted because there was insufficient water in the river to float barges. A large diversion from the Mississippi basin to Georgia which would return directly to the Gulf of Mexico would make such disruption more likely. Moreover, the costs of such a project would not be limited to construction of a pipeline and pumping works. Such a large-scale diversion might be considered a taking, post-*Lucas*,[19] and require compensation to affected downstream riparians. Alabama, because of existing conflict over the waters of the Chattahoochee and the Alabama-Coosa, might be uncertain about the advisability of diverting the Tennessee River. However, it appears certain that Mississippi, Kentucky and other states benefiting from navigation on the Mississippi would oppose such an action by Congress.

5.3.4 Summation - Diverting Tennessee River Water to Georgia

Tennessee-American has riparian rights to withdraw and use water from the Tennessee River but those rights are limited by the equal rights of downstream riparians. The company has no right to withdraw a large amount of water from the river for sale completely out of the Tennessee River basin if any downstream riparians object. The State of Tennessee holds the waters of the state in trust for the people of the state. Even absent specific statutory requirements that a permit be issued before water is withdrawn, the state can act to prevent withdrawals that may damage aquatic environments or existing uses of the river.

Moreover, although the headwaters of several Tennessee tributaries rise in Georgia, Georgia is not a riparian to the Tennessee River. Courts are unlikely to apportion water to a state that is not a riparian.

5.4 West Tennessee, Northern Mississippi, and the Memphis Sand Aquifer - Background

Memphis is one of the largest cities in the world to rely solely on groundwater wells for its water supply.[20] The city's water is provided by a publicly-owned municipal utility, Memphis Light, Gas, and Water (MLGW). MLGW's wells tap into the Memphis Sand Aquifer and the Fort Pillow Sand Aquifer. The former aquifer is an underground reservoir that underlies nearly 7400 mi^2 in West Tennessee, an appreciable extent of Northern Mississippi, a small section of Southwestern Kentucky, and a portion of Eastern Arkansas (see Figure 5.3). Memphis is currently the largest user of the aquifer. However, DeSoto County, Mississippi - an area experiencing rapid economic and population growth, in part due to the "suburbanization" of Memphis - views the aquifer as a potential source of future water supply. According to one estimate, twenty to forty Mgal/d of the City of Memphis groundwater withdrawn from the Memphis Sand Aquifer is thought to come from beneath DeSoto county.[21] Consequently, demands have been increasing to pursue a more integrated, regional, interstate approach to management of the aquifer.

The aquifer, consisting of a 400 - 900 ft. thick layer of very fine to very coarse sand interlaced with beds of clay and silt, has long provided moderate to large volumes of water for public and industrial use in Tennessee and smaller quantities to domestic, farm,

municipal, and industrial users in southwestern Kentucky and northwestern Mississippi. Public and industrial wells in the aquifer range from 80 - 922 feet deep and yield from 10 - 2300 gallons per minute.[22] Withdrawals from the aquifer have been steadily growing in recent years. For example, in 1983, withdrawals averaged 227 Mgal/d - 183 Mgal/d of which were in the Memphis-Shelby County metro area. In 1995, groundwater withdrawals in Shelby County alone totaled 208 Mgal/d.[23] In addition to growing aquifer use, however, there are four major policy challenges facing its management which underscore the complexity of this issue and its policy challenges:

Memphis Sand Aquifer recharge occurs along a broad outcrop belt that stretches across

[p.55] ***West Tennessee.*** Its source is precipitation falling above the outcrop, combined with downward infiltration from overlying fluvial deposits and alluvium. Water moves westward down the dip of the aquifer and toward the major streams draining the area. In recent years, scientists have learned that the recharge area begins just inside southeast Shelby County - where high levels of development are occurring.[24] Thus, balancing local growth against the need to protect the recharge area remains a major challenge which has sparked local efforts (e.g., Collierville, Germantown) to require 'open space' and to place limits on development so as to permit natural 'ponding' of standing water and aquifer recharge.

As a result of long-term pumping (begun in 1886), a cone of depression has developed in the Memphis area. However, it is unclear what

long-term effects this may have. Data from observation wells shows that the water level in Shelby county declined nearly 77 ft. between 1928-1985, an average rate of decline of 1.3 ft/yr. Water levels also are declining in areas away from a "cone" at the center of the aquifer in Memphis., and smaller cones are found around major well field in the city of Memphis. In DeSoto County, Mississippi, for example, declines of one foot or more a year have been reported due to the effects of local pumping, as well as pumping in Memphis.[25] It has not been determined if any "overdrafting" has occurred; i.e., that water levels could not return to normal if pumping ceased. Nor has it been proven that there has been a significant decline in water levels in Mississippi or a measurable effect on well yields in northern Mississippi.

The Memphis Sand Aquifer is susceptible to contamination. Trace constituents of arsenic, barium, cadmium, chromium, copper, lead, mercury, strontium, and zinc - in very small concentrations - have been found in the aquifer. While well below EPA's maximum allowable concentrations for drinking water supplies, their discovery is a cause for concern because the aquifer system constitutes the principal potable water supply source for Memphis and outlying areas. Moreover, it had previously been thought that the aquifer was overlain by a thick, impermeable clay layer protecting it from contamination. Officials now realize the potential for contamination in the vicinity of waste disposal sites, and contaminants are known to be present in water-table aquifers in the Memphis area at several abandoned dump sites.[26]

Mississippi is concerned with declining water levels in the aquifer. Currently, that state derives

80% (2.6 out of a total of 3.3 BGD) of its daily potable water supply from underground sources. Calls for a comprehensive study of groundwater use, groundwater movement between the two states, and the causes of groundwater level declines have been growing, particularly among Mississippi officials. Uncertainty still surrounds the movement of groundwater beneath the two states. It is possible that parties in *either* Tennessee or Mississippi could be impairing the rights of users in the other state if they pump in high quantities. Local experts concur that any multi-jurisdictional approach to managing groundwater will require consensus among many stakeholders. At least one study has attempted to gauge stakeholder attitudes regarding these issues and has concluded that stakeholders in each state perceive a potential threat to its groundwater from users in the other state. In addition, a collaborative study involving several institutions has begun, with involvement by USGS and the Groundwater Institute of the University of Memphis.[27] Mississippi's Department of Environmental Quality is also expected to become a study participant.

The Memphis Sand Aquifer currently faces three interrelated challenges. First, an increase in the current rate of water withdrawal in and around Memphis could have various "recharge" effects. It might serve to continue to lower the water table. On the other hand, it might actually accelerate [p.56] groundwater recharge by downward leakage from the near surface water tables - so called alluvium and fluvial deposits. This, too, is problematic because the quality of the groundwater varies between different aquifers and even within the same aquifer.[28] Second, as DeSoto County and other areas of northwestern

Mississippi continue to grow, competition over available groundwater, and debate over who properly "owns" it, also will grow. Finally, increased water withdrawal as well as improperly managed patterns of land use development may threaten both the recharge of the aquifer and its possible contamination.

5.5 Relevant Legal Principles Regarding the Memphis Sand Aquifer - Overview

MLGW, as the name suggests, supplies electric power and natural gas, as well as water to the population of the City of Memphis and surrounding suburbs. In 1998, MLGW's maximum pumpage to its distribution system was 227.4 Mgal/d, while its minimum pumpage was 118.9 Mgal/day. Daily averages from increased from 140.6 Mgal/d in 1994 to 153.4 Mgal/d in 1998. Most of this water is withdrawn from wells in the Memphis Sand Aquifer, a portion of which underlies the city. MLGW has 10 water pumping stations in Shelby County drawing water from more than 170 wells. MLGW advertises that the aquifer beneath the city has "an abundant supply of high quality water that could accommodate the daily needs of a city several times the size of Memphis."[29]

The common law of groundwater in Tennessee has not been the subject of much litigation. The general view of legal scholars is that Tennessee holds that landowners overlying an aquifer have rights to pump water from the aquifer that are correlative to the rights of other landowners whose land overlies the aquifer. It has been stated that "correlative rights are simply surface riparian law applied to groundwater."[30] While some may disagree with this view, the appellate court in Tennessee has rejected the absolute dominion

rule which allows a surface owner to pump any amount of water from an aquifer regardless of the damage it does to the rights of other landowners overlying the same aquifer.[31] The court concluded that overlying landowners are restricted to a reasonable exercise of their mutual rights in the common source.

MLGW has rights to pump water from the Memphis Sand Aquifer by virtue of the company's ownership of land overlying the aquifer. Under Tennessee law, it is unclear whether MLGW can legally use water from the aquifer to supply water to residents of the city who live on land not overlying the aquifer, if there are any such residents. Under common law, water pumped from an aquifer can only be used on land overlying the aquifer that is owned by the pumper. This is a situation where the common law has not yet caught up with the contemporary reality of large scale pumping for use off-site. However, because MLGW has been pumping water from this aquifer for a considerable period of time, thus far without legal action taken against it, it is unlikely that Tennessee courts would enjoin the company from continuing to pump water and selling it off-site. Whether the amount that is currently being pumped would be allowed by the courts, if there is a complaint by another landowner, is another matter.

If MLGW has been pumping water from the aquifer so as to diminish the flow and pressure to others wells for a period sufficient to allow the company to acquire rights to the water through *prescription* (probably 20 years), then the company may have acquired rights to this water. However, MLGW must have been pumping during that period with the knowledge that, in fact, it had no right to do so. Some scholars are of the opinion, based on California cases, that for prescriptive rights

to groundwater to be obtained, the loss of pressure and flow must have existed for the entire prescriptive period.[32]

[p.57] **5.5.1 Tennessee-Mississippi Liability Problems**

Whether or not MLGW has acquired prescriptive rights to more than its share of the water from the Memphis Sand Aquifer, MLGW - *or any other user of the aquifer* - could potentially be held liable for damages to the ability of other landowners to pump water from the aquifer. Such parties could also be held liable for creating a public nuisance by creating conditions leading to the contamination of the aquifer.

If MLGW pumping has damaged the ability of landowners in Mississippi to pump water for their own land, MLGW may be subject to a suit for damages or an injunction brought by the Mississippi landowners in either Tennessee or Mississippi state court. While the pumping is being done in Tennessee, the damage is occurring in Mississippi. Likewise, the same scenario would hold true in reverse if *Mississippi users impaired* Tennessee users' rights - that is, their courts would have to uphold Tennessee users' rights, as determined by a court of law.

Under Tennessee law, incomplete as the record is, if the volume that MLGW is pumping is unreasonably high, much more than their share of the water from the aquifer, their actions are illegal if another overlying user complains. The courts in Tennessee may only grant damages and not an injunction, however, because the pumping is for municipal purposes

Landowners in Mississippi could bring suit in Mississippi state court if a Tennessee user has damaged the landowners' ability to pump water on their land in Mississippi. The landowners would have to acquire jurisdiction. If such a suit were brought and a judgment favorable to the plaintiffs were rendered in Mississippi, the courts in Tennessee would be required to enforce the judgment under the constitutional requirement of "full faith and credit." If such a suit were brought upon MLGW, the risk is that courts in Mississippi may not have the same concern for maintaining the City of Memphis' access to groundwater, and may direct that MLGW find another source (e.g., the Mississippi River, whose waters are much less pure - see Chapter 6). In any case, should it be determined that MLGW's pumping is excessive, it would probably be illegal under Mississippi law. Mississippi law, which is a regulated riparian system, allows groundwater pumping only by permit for specified amounts.

Because the Memphis Sand aquifer underlies land in several states, it is entirely possible that this dispute could also lead to a suit for apportionment of the waters of the aquifer. MLGW may be vulnerable to suit by the State of Mississippi, acting in the interests of its citizens, to prevent continued pumping of the aquifer in excess of a reasonable amount. The State of Tennessee could be joined in the suit, in its role as trustee for the waters of the state. Such a suit would likely originate in the U.S. Supreme Court as an equitable apportionment suit. The Supreme Court has never apportioned the water in an underground aquifer. The Court has apportioned anadromous fish migrating in interstate waters, however. Thus, its powers to apportion resources are not limited to

surface watercourses. Because the State of Mississippi and the overlying landowners in that state clearly have rights to the water in the Mississippi portion of the aquifer, and because actions by an entity in another state are affecting those rights, it is highly likely that the Court would hear the case. Again, the outcome might be unfavorable to MLGW and Memphis water users because there is another source, the Mississippi River, and MLGW's current use of the aquifer is not legal or equitable under the laws of either state, nor, probably, under the federal common law used by the Court in making an apportionment.

5.5.2 Legal and Political Options for Resolving Potential Aquifer Disputes

[p.58] Rather than allowing the current situation to continue and possible lawsuits to be filed, a far better approach would be for the States of Tennessee and Mississippi to work with MLGW and other aquifer users to lower reliance on the Memphis Sand Aquifer, increase recharge and protect existing recharge areas and the aquifer as a whole, and to continue their efforts in working together to better understand the flow dynamics of the aquifer. The State of Tennessee and the State of Mississippi could work together toward an agreement or even an interstate compact to apportion the aquifer and seek ways to protect it from pollution and overdraft. Because most interstate compacts must be ratified by Congress and signed by the President, they appear may to be daunting endeavors. However, there is no reason that the states cannot work together to find solutions to any over-pumping problems that may exist. It is reasonable to assume that Mississippi would have an interest in such a joint solution because a lawsuit that

charges no present damages but, rather, claims that future development opportunities are being lost will not succeed. Lost opportunities cannot be recovered under riparian law. Even Mississippi, which requires permits for water withdrawals and so is no longer strictly a common law state, would not likely allow recovery for lost opportunity.

5.5.3 Summation - Avoiding Memphis Sand Aquifer Disputes

Under common law, MLGW could be held liable if it is shown that it is pumping in quantities that impair the rights of others whose land overlies the aquifer. Some Mississippi landowners have complained that pumping for Memphis' use is damaging their ability to use the aquifer. If it is shown that the utility has made no effort to fix the problem, it could be held liable. A lawsuit against MLGW or other Tennessee water users for damages to the rights of Mississippi water users could be brought in court in Mississippi. Although the damage was caused by a Tennessee entity, it occurred in Mississippi. Any judgments rendered by the courts in Mississippi would probably have to be accepted by Tennessee *and vice versa.* Under the Full Faith and Credit clause of the U. S. Constitution, Tennessee must enforce a judgment for damages rendered by the courts of another state. Thus, it might be appropriate for Tennessee to act to restrain the pumping by MLGW and to encourage the city to conserve water. If the state does not act, the issue may be taken to court, either by individuals claiming damage to their rights in Mississippi or by a suit in the Supreme Court against Tennessee brought by Mississippi acting for its citizens. As noted earlier, the same scenario would hold true in reverse. If Mississippi users impaired

Tennessee users' rights, their courts would have to uphold Tennessee users' rights.

Endnotes to Chapter 5

(1) See, for example, Gregg, 1996; Jaffe, 1996; H. J. Res. 91, 1997; Graham, 1999; Seabrook, 1999; Arrandale, 1

(2) See: Michael Pare, 1998. "Atlanta Says Doesn't Need City's Water," *Chattanooga Free Press*, December 9

(3) Robert T. Dunphy, 1997. *Moving Beyond Gridlock*. Washington, D.C.; Urban Land Institute, p. 67.

(4) Tom Arrandale, 1999. "The Eastern Water Wars," *Governing* (August): 30-34; and Michael Pare, 1998. "Wate Regional Commission - unpublished report.

(5) Flessner, 1999; Gilbert, 1999a; McAllister, 1999; Walton and Pare, 1999).

(6) Michael Pare, 1998. "Water Company Eyes Role," *Chattanooga Free Press*, July 21: B-1; and "TAWC Boosts Partnership Idea to Chamber," *Chattanooga Times and Free Press*, May 12, 1999; "City Officials Dismiss Water Poll," *Chattanooga Times and Free Press*, May 29, 1999; Judy Walton, "Court Case Crucial to Water Company Takeover," *Chattanooga Times and Free Press*, August 13, 1999; and Judy Walton, "Water Company, City Spar in Court," *Chattanooga Times and Free Press*, August 14, 1999.

(7) Kathy Gilbert (1999). "City Drops Water War," *Chattanooga Times and Free Press*, October 26: A-1; also, for a de Unpublished manuscript, Misty Smith Kelley, Attorney-at-Law.

(8) "Summary of the Resolution of the City of Chattanooga's Efforts to Acquire Tennessee-American Water Comp

[p.59] (9) For details, see Kathy Gilbert (1999). "City Drops Water War," *Chattanooga Times and Free Press*, October 26:
(10) Source: www.tawc.com, J. Frances Alexander, Director of Communications, (423)755-7606
(11) See the TVA Act (1933).
(12) This is not to suggest that Tennessee still subscribes to the "natural flow" theory of water law. Expanding definitions of "reasonable use" and increasing reliance on municipal water systems have made t
(13) Tenn. Code Ann. § 69-8-105.
(14) *Id.*
(15) Tenn. Code Ann. § 69-3-108(b)
(16) See *Public Water Policy in Tennessee*, State of Tennessee Water Policy Commission, Public Administration Service, Chicago, Illinois, 1956.
(17) See Note 10 *supra*.
(18) Grant, Douglas L., *Equitable Apportionment Suits Between States*, in Beck, *Waters and Water Rights* § 45.01-577.
(19) *Lucas v. South Carolina Coastal Council*, 112 S.Ct. 2886 (1992), held that land-use regulation that denies an ov thereby deprives them of economically viable use of their riparian land.
(20) Nicki Robertshaw, 1999. "Memphis' Fine Groundwater a Growing Factor in Construction," Memphis Business Jo
(21) Tom Charlier, 1999. "Memphis Taps into DeSoto County Well Levels," *The Commercial Appeal - Memphis*, Te
(22) See: W. Parks and J.K. Carmichael (1990) *Geology and Ground-Water Resources of the Memphis Sand in Wes the Memphis Aquifer in Western Tennessee.* Water-Resources Investigations Report 88-4180. Memphis, Tennessee: U.S. Geological Survey. Also,

see: J.V. Brahana, et. al. (1987) *Quality of Water from Freshwater Aquifers and Principal Well Fields in the Memphis Area, Tennessee.* Prepared in Cooperation with the City of Memphis, Memphis Light, Gas and Water Division. Water-Resources Inve known as the "500-foot" sand because the aquifer is, in general, about 500 ft. below the surface in the Memphis area. The thickness of the aquifer is from 500-890 ft. in the Memphis area. The aquifer is recharged to the east of Shelby County (see: Ground Water Institute (1995) *A Ground Water Flow Analysis of the Memphis Sand Aquifer in the Memphis, Tennessee Area.* Technical Brief #7, Memphis, Tennessee: University of Memphis, February).

(23) See, "Tennessee Water Use-Data Tabling," 1998. (no author). USGS Website (http:// www.usgs. gov/edu-cgi- Prepared in Cooperation with the City of Memphis, Memphis Light, Gas and Water Division. Water-Resources Investigations Report 93-4075. Memphis, Tennessee: U.S. Geological Survey. Kingsbury and Parks, 1993).

(24) Parks and Carmichael, 1990; also, Robertshaw, 1999.

(25) Charlier, 1999: A9; Ground Water Institute, 1995; Parks and Carmichael, 1990, *Altitude of Potentiometr* Report 89-4048. Memphis, Tennessee: U.S. Geological Survey.

(26) Parks and Carmichael, 1990a; Brahana, Parks, & Gaydos, 1987; Robertshaw, 1999.

(27) For a summary of this stakeholder interview study, see John Wingard (2000), *The Community Dynamics of Source Water Protection: the Structure and Dynamics of the Human Dimensions of Source Wate the Minds. Source Water Protection Workshops, Coordinated by the Ground Water Institute of the*

University of Memphis (Memphis, TN: University of Memphis); also, Charlier, 1999).
(28)Brahana, Parks, and Gaydos, 1987.
(29) <www.mlgw.com.>
(30) Tarlock, A. Dan, *Law of Water Rights and Resources*, § 4.06(3)
(31) See *Nashville, Chattanooga & St. Louis v. Rickert*, 19 Tenn. App. 446, 89 S.W.2d 889 (1935), *cert denied* (1936
(32) Tarlock, *supra* note 11.

EXHIBIT 7

Special Report

Tennessee's Water Supply:

Toward A Long-Term Water Policy for Tennessee

Dan Cohen-Vogel, Ph.D.
Principal Research Analyst
and
Greg Spradley
Senior Research Analyst

Ethel Detch, Director
Douglas W. Wright, Assistant Director
Office of Research
505 Deaderick Street, Suite 1700
Nashville, TN 37243
615/401-7911
www.comptroller.state.tn.us/orea/reports

John G. Morgan
Comptroller of the Treasury

March 2002

* * *

[p.6] source to the Columbia region.[8] This situation requires regulators, local governments and utility districts, and TDEC to carefully examine the potential effects of proposed activities both upstream and downstream of the dam and to work together to maintain the hydrologic system to support everyone's needs.

Case 3: Memphis Sand Aquifer

The city of Memphis, through Memphis Light, Gas and Water (MLGW), is one of the largest cities in the world to rely solely on ground water for its water supply. The city's wells tap into the Memphis Sand Aquifer, an underground reservoir that underlies nearly 7,400 square miles in West Tennessee, Northern Mississippi, Southwestern Kentucky, and Eastern Arkansas. The largest user of the aquifer, MLGW pumped an average of 208 million gallons per day in 1995, with an estimated 20 to 40 million gallons per day thought to be coming from beneath DeSoto County, Mississippi. This area of Mississippi has experienced rapid economic and population growth, in part due to the "suburbanization" of Memphis, and views the aquifer as a potential future water source, adding an interstate dimension to this case of water scarcity.[9]

---

[8] Tennessee Valley Authority, "Use of Land Acquired for the Columbia Dam Component of the Duck River Project," http://www.tva.gov/environment/reports/columbiaeis/index.htm (accessed February 13, 2002).

[9] David Lewis Feldman and Julia O. Elmendorf, *Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need*

The aquifer's recharge area appears to begin just inside southeast Shelby County, Tennessee (an area of intense development) and to extend east into Fayette County. Balancing local growth against the need to protect the recharge area remains a major challenge and has sparked local efforts to require open space and limit development to permit natural ponding of standing water and allow aquifer recharge. Memphis Light, Gas and Water and DeSoto County, Mississippi, officials note that as a result of long-term pumping, a cone of depression has developed in the Memphis area. Observation wells showed a decline in water levels of 77 feet between 1928 and 1985; water levels away from the cone in Memphis have also shown a decline. There are smaller cones around a major well field in Memphis, and DeSoto County has reported declines of one foot or more per year, apparently because of pumping locally and in Memphis. It is not clear whether water levels could return to normal if pumping ceased, nor has it been proven that there has been a significant decline in water levels or a measurable effect on well yields in Northern Mississippi or other areas. Also, traces of contaminants such as arsenic, lead, and mercury have been found in water from the aquifer. Though well below EPA's maximum allowable concentrations for drinking water supplies, this discovery is troubling to those who use water from the aquifer, because it demonstrates the aquifer's susceptibility to contamination in the vicinity of waste disposal sites and abandoned dump sites. This evidence of susceptibility is also contrary to previously held beliefs

---

for Long-Term Planning (Knoxville, TN: Energy, Environment and Resources Center, 2000), pp. 50-53.

that a layer of clay overlying the aquifer protected it from such contamination.[10]

Officials in both Mississippi and Tennessee have called for a comprehensive study of ground water use, the movement of ground water between Mississippi and Tennessee, and the causes of declines in ground water levels. In response, the Sundquist Administration helped create the Mississippi, Arkansas, and Tennessee Regional Aquifer Study (MATRAS) to study shared [p.7] ground water issues.[11] While common law pertaining to ground water has not been extensively tested by litigation in Tennessee, legal scholars generally view rights to ground water as held by overlying landowners with some limitations. An appellate court in Tennessee has concluded that the rights of a landowner are restricted to activities that do not interfere with the rights of other landowners overlying the same aquifer.[12] However, Memphis has been pumping water from the aquifer for so long that MLGW may have acquired rights to the water through *prescription*.[13] A number of other legal issues surround

---

[10] *Ibid.*

[11] Tennessee Department of Environment and Conservation, "Report from Multi-State Water Supply Research Project," http://www.state.tn.us/environment/epo/hotlist.htm#WaterResearch (accessed February 8, 2002).

[12] David Lewis Feldman and Julia O. Elmendorf, *Water Supply Challenges Facing Tennessee: Case Study Analyses and the Need for Long-Term Planning* (Knoxville, TN: Energy, Environment and Resources Center, 2000), pp. 52-53.

[13] Acquiring ground water rights through "prescription" means acquiring the rights through long-term pumping without the other

this case, including each state's liability to the other and the ability to prove damage. It appears better for parties in the three states to work together toward a mutually acceptable solution than to resolve the issue through litigation. Such a solution would probably include reducing MLGW's reliance on the aquifer.

Case 4: Lake Levels in East Tennessee

In December 2000, Congress agreed to fund a study by the University of Tennessee examining the economic impact on East Tennessee counties if the Tennessee Valley Authority (TVA) were to delay the annual drawdown of its reservoirs there. Current TVA policy lowers, or "draws down," water levels in TVA lakes beginning in August. TVA rationale for the drawdowns include hydroelectric power generation, flood control, navigation, and environmental demands.[14] These reservoirs have a significant financial impact on the surrounding communities because of the tourist and recreation dollars they attract. Drawing the lakes down in August renders them unusable or unattractive to recreational users during months when the weather supports recreational uses, reducing local business revenues, state and local sales taxes, and property values.

An October 1998 report by the UT Center for Business and Economic Research examined the economic impact of keeping water levels in two East Tennessee Lakes

---

users taking any action, though it may affect yields of other users of the same aquifer.

[14] Richard Powelson, "Congress funding study of TVA lake levels," *Knoxville News-Sentinel*, December 17, 2000.

constant during the months of August and September rather than beginning the drawdown in August. The table at the top of the next page summarizes the findings of that study and comparisons with other similar studies.

* * *

APPENDIX H

Examples of Decisional Law, Legislative Enactments and Constitutional Provisions of Various States Declaring State-Ownership and Control of Water Resources as a Function of Statehood and Inherent Sovereignty and Examples of Federal and State Studies Confirming the Diversion of Mississippi's Ground Water by Memphis-MLGW

A. Examples of Reported Decisions Confirming "State-Ownership" of Water Resources

- *Phillips Petroleum Co. v. Mississippi*, 484 U.S. 469, 479 (1988) (affirming *Cinque Bambini Partnership v. State of Mississippi*, 491 So.2d 508, 511-14, 516-17 & 519-20 (1986) (effective upon statehood, on March 1, 1817, the United States granted to Mississippi in trust all water and other resources within the State's territorial boundaries);

- *National Audubon Society v. The Superior Court of Alpine County*, 658 P.2d 709, 724, 727-28 (Calif. 1983) (all water within state is property of people of the state; state, as sovereign, retains control of waters)

- *Chatfield East Well Co., Ltd. v. Chatfield East Property Owners,* 956 P.2d 1260 (Colo. 1998) (all surface and ground water is a public resource)

- *California Oregon Power Co. v. Beaver Portland Cement Co.*, 295 U.S. 142, 163-64 (1935) (waters of

the public domain are *publici juris*, subject to plenary control of the states);

- *Monte Vista Canal Co. v. Centennial Irrigating Ditch Co.*, 123 P.831 (Colo. App. 1912) (ultimate title or ownership of water of state is vested in public);

- *Bennett v. Twin Falls North Side Land and Water Co.*, 150 P. 336, 338-39 (Idaho 1915) (ownership of the corpus of the water is in the state);

- *State Game & Fish Comm'n v. Louis Fritz Co.*, 187 Miss. 539, 193 So. 9 (1940) (State is the owner of water within its borders and incident to this ownership is right and duty to protect and conserve it under State's police powers connected with its ownership of water in trust for the people);

- *State, ex rel. Rice v. Stewart*, 184 Miss. 202, 184 So. 44 (1938) (State has power, as trustee, to bring trespass action to recover value of subterranean resources removed from river bed);

- *Ex parte Louis Fritz*, 86 Miss. 210, 38 So. 722, 723 (1905) (ownership of *ferae naturae* is in the state in its sovereign capacity; state has right and duty to preserve and protect public resources from trespassers);

- *Barry v. Merickel Holding Corp.*, 108 P.2d 311, 314-15 (Nev. 1940) (all water of state, whether above or beneath the surface of the ground, belongs to state; water being state property, the state has the right and power to prescribe how it may be used);

- *Johns-Manville Sales Corp. v. New Jersey Water Supply Auth.*, 211 N.J. Super. 315, 511 A.2d 1194, 1195-97 (1986) (water resources are public assets held by state; ultimate ownership of state of precious natural resources is held by state for public's use);

- *New Mexico v. City of Las Vegas*, 89 P.3d 47, 61 (N.M. 2004) (all water within state belongs to state);

- *State v. Erickson,* 308 P.2d 983 (N.M. 1957) (all water within the state, whether above or beneath the surface of the ground, belongs to the state; the state as owner has right to prescribe how water may be used);

- *State Game Comm'n v. Red River Valley Co.*, 182 P.2d 421 (N.M. 1945) (water held to belong to public);

- *United Plainsmen Ass'n v. North Dakota State Water Conserv. Comm'n*, 247 N.W.2d 457, 461 (N.D. 1976) (all streams and natural water courses shall forever remain property of state; all water within limits of state held by state by virtue of its sovereignty);

- *Parks v. Cooper*, 676 N.W.2d 823, 838 (S.D. 2008) ("we align ourselves with the Idaho, Iowa, Minnesota, New Mexico, Montana, North Dakota, Oregon, Utah and Wyoming decisions that have recognized the public trust doctrine's applicability to state waters").

- *Murphy v. Kerr,* 296 F.536 (D.N.M. 1923) (Court noted that Arizona, Colorado, California, Montana, Nevada, New Mexico, Oklahoma, Oregon, North Dakota, South Dakota, Texas, Utah, Wyoming and Idaho have declared that "all waters within the state are the property of the public, and belong to the state").

B. Examples of Legislative Enactments Declaring "State-Ownership" of Water Resources

- Alabama's "Water Resources Act," ALA. CODE ANN. §9-10B-1 (all waters of the state, above or below surface of ground, are the resources of state);

- Arizona's "Groundwater Management Act," ARIZONA STAT. §45-401 (groundwater of state made subject to state management and regulation);

- Arkansas' "Ground-water Protection and Management Act" §15-22-302 (mandate for reporting use of ground water to state);

- Delaware's "Natural Resources-Environment Control" Law, DEL. CODE ANN. Tit. 7, §6001 (the state, in the exercise of its sovereign power, controls development and use of land and water resources of state);

- Florida's "Water Resources Act," FLA. STAT. ANN. §373.016 (waters of state are its basic resources controlled by state for benefit and use of public);

- Georgia's "Ground-Water Use Act," GA. CODE ANN. §12-5-91 (the water resources of the state are to be regulated in public interest);

- Indiana's "Waters Rights; Ground Water" Law, IND. CODE ANN. §14-25-3-4 (ground water resources of state protected and regulated for citizens' beneficial use);

- Iowa's "Resources Enhancement and Protection" Law, IOWA CODE ANN. §455A.16 (state's natural resources subject to state protection);

- Kentucky's "Geology and Water Resources" Law, KY. REV. STAT. ANN. §151.120 (water occurring in any stream, lake, ground water, or subterranean water in Commonwealth is declared to be a natural resource and public water of the Commonwealth subject to control and regulation for the public);

- Minnesota's "Water Policy," MINN. STAT. ANN. §103A.201 (public waters are subject to control of the state);

- Mississippi's "Omnibus Water Rights Act," MISS. CODE ANN. §51-3-1 (all water, whether occurring on the surface of the ground or beneath it, is among the basic resources of Mississippi; the State, in the exercise of its police powers (derived from the public trust), has control of development, management and use of water in the State);

- New Jersey's "Waters and Water Supply Management" statutes, N.J. STAT. ANN. §58:1A-2 (water resources of state are public assets of state held in trust for people);

- New York's "Water Resources Law," N.Y. ENVTL. CONSERV. LAW §15-0103 (sovereign power to regulate and control water resources of state "ever

since its establishment has been and now is vested exclusively in the state");

- South Carolina's "Groundwater Use and Reporting Act," S.C. CODE ANN. §49-5-20 (groundwater resources of the state subject to regulation to protect resources and maintain conditions for use by public);

- Tennessee's "Water Quality Control Act," TENN CODE ANN. §69-3-102 (the waters of Tennessee are the property of the state and are held in the public trust for the use of the people of the state);

- Virginia's "Water Policy" Law, VA. CODE ANN. §62.1-11 (state's waters are natural resource regulated, controlled and protected by Commonwealth in exercise of its police powers).

C. Examples of Eastern States Adopting Regulated Riparianism Predicated on State Ownership of Water Resources

- States that have active regulated riparian systems and the approximate date of that adoption are as follows: Alabama (1993); Arkansas (1957); Connecticut (1982); Delaware (1959); Florida (1972); Georgia (1977); Hawaii (1987); Iowa (1957); Kentucky (1966); Maryland (1957); Massachusetts (1985); Minnesota (1973); **Mississippi (1985)**; New Jersey (1965); North Carolina (1973); New York (1979); Virginia (1989); and Wisconsin (1957). *Compare* MISS. CODE ANN. §51-3-1 (1985 & Supp. 2006) *with* ALA. CODE §9-10B-2; CONN. GEN. STAT. ANN. §22a-366; DEL. CODE ANN. TIT. 7, §6001; FLA. STAT. ANN. §373.016; GA. CODE ANN. §§12-5-21, 12-

5-91; HAW. REV. STAT. §174C-2(A); IND. CODE ANN. §13-12-1-8; IOWA CODE ANN. §455B.262(3); KY. REV. STAT. ANN. §151.110; MD. CODE ANN. NAT. RES. §8-801(1); MINN. STAT. ANN. §105.38; N.J. STAT. ANN. §58:1A-2; N.Y. ENVTL. CONSERV. LAW §§15-0103, 15-0105(1); N.C. GEN. STAT. §143-215.12; VA. CODE ANN. §62.1-11; VA. CODE ANN. §62.1-44.36, 62.1-44.84; and WIS. STAT. ANN. §144.25(1). *See also* American Society of Civil Engineers, "Regulated Riparian Model Water Code," Section 1-R-1-01 at 1 (2004) ("the waters of the State are a natural resource owned by the State in trust for the public and subject to the State's sovereign power to plan, regulate and control the withdrawal and use of those waters").

D. Examples of State Constitutional Provisions and Other Statutes Confirming State-Ownership of Water Resources

- Wyoming Constitution, Article 8, Section 1 (declares that "the water of all natural streams, springs, lakes or collection of still water within the boundaries of the state are . . . the property of the state.");

- Colorado Constitution, Article XVI, Section 5 (declares that "the water of every natural stream, not heretofore appropriated, within the State of Colorado, is declared to the property of the public, and the same is dedicated to the use of the people of the State, subject to appropriate as hereinafter provided.");

- Montana Constitution, Article IX (declares that all water within the state, including underground

water, is the property of the state, and that all its use is a "public use" notwithstanding its user or purpose.);

- New Mexico Constitution, Article XVI, Sections 1, 2 (declares that all the "water of every natural stream, perennial or torrential, within the state" unappropriated at the time of statehood, "belong(s) to the public.");

- California Constitution, Article 10, Section 5 (provides that "the use of all water" by appropriation is a "public use" and subject to the regulation and control of the state.");

- Nevada Revised Statutes, 533.125 (provides that "the water of all sources of water supply within the boundaries of the state, whether above or beneath the surface of the ground, belongs to the public");

- North Dakota Century Code, §61-01-01 (declares both surface and ground water to "belong to the public");

- Utah Code, §73-1-1 (declares that all waters in the state, whether above or under the ground are hereby declared to be the property of the public, subject to all existing rights to the use thereof");

- Oregon Revised Statutes 537.110 (provides that all waters of the state, whether above or below the ground, are the property of the public);

- Nebraska Revised Statutes §46-202(1) (provides that the water of every natural stream not heretofore appropriated within the State of

Nebraska, including the Missouri River, is hereby declared to be the property of the public and is dedicated to the use of the people of the state, subject to appropriation);

- Washington's Legislation set forth in RCW §90.03.010 (provides that all waters within the state belong to the public);

- Idaho Code §42-101 (declares that all its water resources belong to the state);

- California Water Code, Section 1201 (provides that surface waters are "public waters of the state");

- Texas Water Code §11.021 (declares that surface water is the "property of the state").

E. Scientific Reports. Studies and reports prepared by the United States Geological Survey ("USGS") during the 1960's, 1970's, 1980's, 1990's, and in this decade, and the University of Memphis Ground Water Institute ("GWI") during the 1990's and currently, with funding from and in cooperation with MLGW and Memphis, have confirmed the existence of the cone of depression and the fact that it extends into, diverts and captures ground water from beneath Mississippi. These scientific reports include:

- Gerald K. Moore, *Geology and Hydrology of the Claiborne Group in Western Tennessee*: U.S. Geological Survey Water-Supply Paper 1809-F (1965) (Moore reported that, under conditions of heavy pumping in Memphis, 25 million gallons per day of aquifer ground water were being diverted

from Mississippi into Shelby County as early as 1960);

- D. D. Graham & W. S. Parks, *Potential for Leakage Among Principal Aquifers in the Memphis Area, Tennessee*: U.S. Geological Survey Water-Resources Investigations Report 85-4295 (1986) (Graham studied early potentiometric surface maps from 1886, 1960, 1970 and 1975 (appearing in work by USGS scientists, Criner & Parks, 1976) for the purpose of demonstrating that the cone of depression caused by pumping in the Memphis area extended across the Tennessee-Mississippi line into Desoto County, Mississippi);

- John V. Brahana & R. E. Broshears, *Hydrogeology and Ground-Water Flow in the Memphis and Fort Pillow Aquifers in the Memphis Area, Tennessee*: Water Resources Investigations Report 89-4131 (2001) (Brahana, a long-time consulting expert for Memphis and MLGW, reported that, as of 1980, withdrawals were 200 million gallons a day in the Memphis area and that Memphis' pumpage had altered the pre-pumping flow of the aquifer, effectively capturing most of the water flowing through it, including ground water from northwest Mississippi, primarily Desoto County);

- James Kingsbury, *Altitude of the Potentiometric Surface, September 1990, and Historical Water-Level Changes in the Memphis Aquifer in the Memphis Area, Tennessee* (1990) (map depicts cone of depression as extending across the Shelby County-Desoto County border into Mississippi);

- W. S. Parks & J. K. Carmichael, *Altitude of Potentiometric Surface, Fall 1985, and Historic Water-Level Changes in the Memphis Aquifer in Western Tennessee,* U.S. Geological Survey Water-Resources Investigations Report 88-4180 (1990a) (Parks and Carmichael found significant declines in the water levels in the aquifer for the period 1928-1983);

- J. Kerry Arthur & R. E. Taylor, *Definition of the Geohydrologic Framework and Preliminary Simulation of Ground-Water Flow in the Mississippi Embayment Aquifer System, Gulf Coastal Plain, United States*: U.S. Geological Survey Water-Resources Investigation Report 86-4364 (1990) (regional ground water model demonstrated the change in the natural east to west aquifer flow path and gradient to a northern direction into the cone of depression created by pumpage in Memphis; Arthur concluded that, as of 1980, approximately 30% of MLGW's water supply was being derived from the ground water system beneath Mississippi);

- J. Outlaw, *A Ground Water Flow Analysis of the Memphis Sand Aquifer in the Memphis, Tennessee, Area*, University of Memphis Ground-Water Institute (1994) (GWI concluded that the majority of the water withdrawn by the municipal well fields in Shelby County originates in the eastern part of Shelby County, Fayette County, Tennessee, and Desoto and Marshall Counties, Mississippi, as a result of the regional cone of depression extending into northwest Mississippi).

APPENDIX I

UNITED STATES COURT OF APPEALS FOR THE FIFTH CIRCUIT

No. 08-60152

[Dated July 18, 2008]

JIM HOOD, Attorney General, ex rel., THE STATE OF MISSISSIPPI, Acting for Itself and *Parens Patriae* for and on behalf of the People of the State of Mississippi,

Plaintiff-Appellant

v.

THE CITY OF MEMPHIS, TENNESSEE, and MEMPHIS LIGHT, GAS & WATER DIVISION,

Defendants-Appellees

On Appeal from the United States District Court for the Northern District of Mississippi, Delta Division (2:05CV32-D-B)

AMICUS CURIAE BRIEF OF THE STATE OF TENNESSEE IN SUPPORT OF THE CITY OF MEMPHIS, TENNESSEE, AND MEMPHIS LIGHT GAS AND WATER DIVISION AND

REQUESTING AFFIRMANCE OF THE DISTRICT COURT

ROBERT E. COOPER, JR.,
Attorney General and Reporter
BARRY TURNER,
Deputy Attorney General
Office of the Tennessee Attorney General and Reporter
P.O. Box 20207
Nashville, Tennessee 37202
(615) 532-2586

SUPPLEMENTAL STATEMENT OF INTERESTED PERSONS/ENTITIES

NO. 08-60152

UNITED STATES COURT OF APPEALS FOR THE FIFTH CIRCUIT

JIM HOOD, Attorney General, ex rel., THE STATE OF MISSISSIPPI, Acting for Itself and *Parens Patriae* for and on behalf of the People of the State of Mississippi,	)
Plaintiff-Appellant	)
v.	)
THE CITY OF MEMPHIS, TENNESSEE, and MEMPHIS LIGHT, GAS & WATER DIVISION,	)
Defendants-Appellees	)

The undersigned counsel of record certifies that the following listed persons and entities as described in Fifth Circuit Rule 28.2.1 have an interest in the outcome of this case. These representations are made in order that the judges of this Court may evaluate possible disqualification or recusal.

1. State of Tennessee, *Amicus Curiae*

2. Robert E. Cooper, Jr., Attorney General and Reporter for the State of Tennessee

3. Barry Turner, Deputy Attorney General for the State of Tennessee

/s/
BARRY TURNER (TN. Bar No. 9669)
Deputy Attorney General
Environmental Division
Office of the Tennessee Attorney General and Reporter
P.O. Box 20207
Nashville, Tennessee 37202
(615) 532-2586

TABLE OF CONTENTS

TABLE OF AUTHORITIES

CASES

FEDERAL STATUTES

STATE STATUTES

OTHER AUTHORITY

INTEREST OF THE STATE OF TENNESSEE AS *AMICUS CURIAE*

The State of Tennessee submits this brief as *amicus curiae* in support of appellees, the City of Memphis and Memphis Light, Gas and Water, and in accordance with Fed. R. App. P. 29 and 5th Cir. R. 29. The district court held that resolution of this case requires an equitable apportionment of the ground water in the Memphis Sands aquifer that underlies the states of Mississippi and Tennessee, as well as other states.[1] An equitable apportionment would implicate the sovereign interest of Tennessee in the aquifer ground water within its borders. This interest arises from Tennessee's power as sovereign to regulate this natural resource for the benefit of its citizens. The State of Mississippi would obviously have a comparable interest in the aquifer ground water within its borders.

Because of its sovereign interest in the aquifer ground water, Tennessee would be a necessary and indispensable party to an equitable apportionment action. And as the district court properly concluded, original and exclusive jurisdiction of such an action would be in the United States Supreme Court.

---

[1] The Memphis Sands aquifer lies under several states, including the State of Arkansas. Without determining that Arkansas is an indispensable party to this action, the district court directed that the Arkansas Attorney General should be put on notice of the pendency of this action and any future action filed in the United States Supreme Court. *Hood ex rel. Mississippi v. City of Memphis*, 533 F.Supp.2d 646, 650-51 (N.D. Miss. 2008).

ARGUMENT
THE STATE OF TENNESSEE WOULD BE A NECESSARY AND INDISPENSABLE PARTY TO AN EQUITABLE APPORTIONMENT ACTION IN THE UNITED STATES SUPREME COURT

In this lawsuit, appellant, the State of Mississippi, seeks damages for an alleged continuing trespass and conversion of the ground water in the Memphis Sands aquifer by appellees, the City of Memphis and Memphis Light, Gas and Water (collectively Memphis). In essence, Mississippi is alleging that Memphis has unlawfully taken Mississippi's property, *i.e.*, its ground water, and that Mississippi should be compensated for its loss. Brief of Appellants at 5, 39-44. In granting Memphis' motion to dismiss, the district court held, in part:

> [T]he State of Tennessee is a necessary and indispensable party. . . . The subject aquifer in the case *sub judice* has not been apportioned, neither by agreement of the involved States nor by the U.S. Supreme Court. However, absent apportionment, this court cannot afford relief to the Plaintiff and hold that the Defendants are pumping water that belongs to the State of Mississippi, because it has not yet been determined which portion of the aquifer's water is the property of which State. It is simply not possible for this court to grant the relief Plaintiff seeks without engaging in a *de facto* apportionment of the subject aquifer; such relief, however, is in the original and exclusive jurisdiction of the United States Supreme Court because such a dispute is necessarily between

> the State of Mississippi and the State of Tennessee.

Hood ex rel. Mississippi v. City of Memphis, 533 F.Supp.2d at 648.

As noted, the Memphis Sands aquifer is an interstate water body underlying Tennessee and Mississippi, as well as other states in the region. Tennessee certainly has an interest as sovereign in the ground water within its borders. Like other natural resources, the ground water in Tennessee is held by the state in "public trust for the use of the people of the state[.]" Tenn. Code Ann. § 69-3-102(a) (2004). As sovereign, Tennessee may exercise its police power to regulate ground water so as to protect and conserve this public resource.

As the district court correctly held, no specific volumes of ground water in this interstate aquifer have been allocated either to Mississippi or to Tennessee.[2] Such an allocation may occur through a compact approved by Congress, or through an equitable apportionment. *See Hinderlider v. La Plata River & Cherry Creek Ditch Co.*, 304 U.S. 92, 104 (1928) (a compact and an equitable apportionment are "the two means provided by the Constitution for adjusting interstate [water] controversies").

"Equitable apportionment is the doctrine of federal common law that governs disputes between states

---

[2] Similarly, no specific volumes of aquifer ground water have been allocated to Arkansas, or to any other state under which the aquifer lies.

concerning their rights to use the water of an interstate stream."[3] *Colorado v. New Mexico,* 459 U.S. 176, 183 (1982). The United States Supreme Court has "original and exclusive jurisdiction of all controversies between two or more states."[4] 28 U.S.C. § 1251(a) (2000); *see also* U.S. Const. art III, § 2 (extending judicial power of the United States "to controversies between two or more states").

Although the Supreme Court has not yet applied the equitable apportionment doctrine to an interstate aquifer, it has described the applicability of the doctrine in broad terms:

> [W]henever . . . the action of one state reaches, through the agency of natural laws, into the territory of another state, the question of the extent and the limitations of the rights of the two states becomes a matter of justiciable dispute between them, and this court is called upon to settle that dispute in such a way as will

---

[3] "Equitable apportionment is directed at ameliorating present harm and preventing future injuries to the complaining State, not at compensating that State for prior injury." *Idaho* ex rel. *Evans* v. Oregon, 462 U.S. 1017, 1028 (1983). Thus, a damages claim is not appropriate for consideration in an equitable apportionment action.

[4] The Supreme Court has expressed a preference that before pursuing an equitable apportionment action, states should attempt to resolve by compact any disputes regarding the use of interstate waters. *Colorado v. Kansas*, 320 U.S. 383, 392 (1943) (such controversies may be resolved "by negotiation and agreement, pursuant to the compact clause . . . instead of invocation of our adjudicatory power").

> recognize the equal rights of both and at the same time establish justice between them.

Kansas v. Colorado, 206 U.S. 46, 97-98 (1907). Consistent with this broad view, the Court has applied the equitable apportionment doctrine to a controversy over the allocation of fish that migrate between states. *See Idaho ex rel. Evans v. Oregon,* 462 U.S. at 1024 ("Although that doctrine has its roots in water rights litigation, the natural resource of anadromous fish is sufficiently similar to make equitable apportionment an appropriate mechanism for resolving allocative disputes").

In an equitable apportionment action, the Supreme Court could conclude that the existing withdrawals of ground water from the aquifer in Tennessee are equitable. *See, e.g., Colorado v. Kansas*, 320 U.S. at 391 ("it did not then appear that Colorado had appropriated more than her equitable share of the flow"). Alternatively, the Court could limit the total volume of aquifer ground water that may be withdrawn by users in Tennessee. *See, e.g., New Jersey v. New York*, 283 U.S. 336, 346 (1931) (limiting New York to diverting no more than "440 million gallons of water daily" from the Delaware River).

An action to equitably apportion the ground water in the Memphis Sands aquifer would implicate the sovereign interests of Tennessee. *Colorado v. New Mexico*, 459 U.S. at 182, n. 9 ("Colorado surely has a sovereign interest in the beneficial effects of a diversion [from interstate waters] on the general prosperity of the State"); *Kansas v. Colorado*, 206 U.S. at 99 (controversy over withdrawals from interstate river "involves a matter of state interest"). Because of

this sovereign interest, Tennessee would be a necessary and indispensable party to an equitable apportionment action. *Cf. Arizona v. California*, 298 U.S. 558, 571 (1936) (United States is a necessary party in equitable apportionment action because the "'equitable share' of Arizona in the unappropriated water impounded above Boulder Dam could not be determined without ascertaining the rights of the United States").

CONCLUSION

An equitable apportionment of the ground water in the Memphis Sands aquifer would implicate Tennessee's sovereign interest in regulating this natural resource for the public benefit. Original and exclusive jurisdiction of an equitable apportionment action lies in the United States Supreme Court. Because of its sovereign interest in an apportionment of the aquifer ground water, Tennessee would be a necessary and indispensable party to such an action. Accordingly, the district court appropriately dismissed this action, and the district court's ruling should be upheld.

Respectfully submitted,

/s/ Robert E. Cooper, Jr. *by Michel E. Moore,*
ROBERT E. COOPER, JR. *Solicitor General,*
(TN. Bar No. 10934) *at his direction.*
Attorney General and Reporter
State of Tennessee

/s/ Barry Turner
BARRY TURNER
(TN. Bar No. 9669)

Deputy Attorney General
Environmental Division
P.O. Box 20207
Nashville, Tennessee 37202
(615) 532-2586

CERTIFICATE OF SERVICE

I, the undersigned, hereby certify that a true and correct copy of the foregoing has been served by U.S. Mail, postage prepaid, this the 18th day of July, 2008, upon the following counsel of record:

John W. (Don) Barrett
David M. McMullan, Jr.
404 Court Square North
Lexington, MS 39095

Alan B. Cameron
Larry D. Moffett
Oxford Square North
265 North Lamar Boulevard, Suite R
Oxford, MS 38655

George B. Ready
Post Office Box 127
Hernando, MS 38632

Geoffrey C. Morgan
Office of the State Attorney General State of Mississippi
Post Office Box 220
Jackson, MS 39205-0220

Leo M. Bearman
David L. Bearman

Kristine L. Roberts
Chad D. Graddy
Baker, Donelson, Bearman, Caldwell & Berkowitz, PC
165 Madison Ave., Suite 2000
Memphis, TN 38103

Walker W. Jones, III
Barry W. Ford
Baker, Donelson, Bearman, Caldwell & Berkowitz, PC
Meadowbrook Office Park
4268 I-55 North
Jackson, MS 39211

Elbert Jefferson, Jr.
Office of City Attorney, City of Memphis
125 North Main Street, Room 314
Memphis, TN 38103

Charlotte Knight Griffin
Memphis Light, Gas & Water Division
220 South Main Street
Memphis, TN 38103

/s/
BARRY TURNER, (TN. Bar No. 9669)
Deputy Attorney General
Environmental Division
Office of the Tennessee Attorney General
and Reporter
P.O. Box 20207
Nashville, Tennessee 37202
(615) 532-2586

CERTIFICATE OF COMPLIANCE

1. This brief complies with the type-volume limitation of FED. R. APP. P. 32(a)(7)(B) because:

[X] **a. This brief contains 1,220 words, excluding the parts of the brief exempted by FED. R. APP. P. 32(a)(7)(B)(iii).**

[ ] b. This brief uses a monospaced typeface and contains ____ lines of texts, excluding the parts of the brief exempted by FED. R. APP. P. 32(a)(7)(B)(iii).

2. This brief complies with the typeface requirements of FED. R. APP. P. 32(a)(5) and the type style requirements of FED. R. APP. P. (32)(a)(6) because:

[X] **a. This brief has been prepared in a proportionally spaced typeface using Word 2003 in Times New Roman font, 14 point.**

[ ] b. This brief has been prepared in a monospaced typeface using ____ with ____.

/s/ Barry Turner
BARRY TURNER, (TN. Bar No. 9669)
Deputy Attorney General
Environmental Division
Office of the Tennessee Attorney General and Reporter

P.O. Box 20207
Nashville, Tennessee 37202
(615) 532-2586