

Exhibit No.:
Issues: Weather Normalization
Witness: Edward L. Spitznagel, Jr
Exhibit Type: Rebuttal Testimony
Sponsoring Party: Missouri-American Water
Company

Case No.: WR-2003-0500
Date Filed: November 10, 2003

MISSOURI PUBLIC SERVICE COMMISSION

CASE NO. WR-2003-0500

FILED

JAN 23 2004

**REBUTTAL TESTIMONY
OF
EDWARD L. SPITZNAGEL, JR.**

**Missouri Public
Service Commission**

**ON BEHALF OF
MISSOURI-AMERICAN WATER COMPANY**

JEFFERSON CITY, MISSOURI

**REBUTTAL TESTIMONY
EDWARD L. SPITZNAGEL, JR.
MISSOURI-AMERICAN WATER COMPANY
CASE NO. WR-2003-0500**

Exhibit No. 45
Case No(s) WR-2003-0500
Date 12/16/03 Rptr SKM

EXHIBIT


MAWC 45

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

IN THE MATTER OF MISSOURI-AMERICAN)	CASE NO. WR-2003-0500
WATER COMPANY FOR AUTHORITY TO FILE)	
TARIFFS REFLECTING INCREASED RATES)	
FOR WATER SERVICE)	
)	

AFFIDAVIT OF EDWARD L. SPITZNAGEL, JR.

Edward L. Spitznagel, Jr., being first duly sworn, deposes and says that he is the witness who sponsors the accompanying rebuttal testimony entitled "Rebuttal Testimony of Edward L. Spitznagel, Jr."; that said rebuttal testimony and schedules were prepared by him and/or under his direction and supervision; that if inquires were made as to the facts in said rebuttal testimony, he would respond as therein set forth; and that the aforesaid rebuttal testimony and schedules are true and correct to the best of his knowledge.


Edward L. Spitznagel, Jr.

State of Missouri
County of St. Louis
SUBSCRIBED and sworn to
before me this 6th day of November, 2003.


Notary Public

My commission expires: 2-22-2004

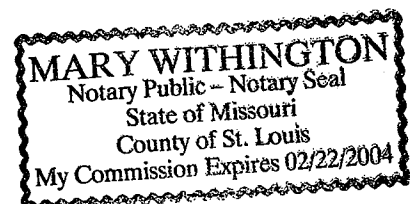


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EDWARD L. SPITZNAGEL, JR.
MISSOURI-AMERICAN WATER COMPANY
CASE NOS. WR-2003-0500

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1 **WITNESS INTRODUCTION**

2

3 **Q. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND EMPLOYER.**

4

5 A. My name is Edward L. Spitznagel, Jr., and my business address is Campus Box 1146, One
6 Brookings Drive, St Louis, Missouri 63130. I am employed by Washington University.

7

8 **Q. WHAT IS YOUR PRESENT POSITION?**

9

10 A. I am Professor of Mathematics in the College of Arts and Sciences at Washington University.
11 I also hold a joint appointment in the Division of Biostatistics of the Washington University
12 School of Medicine.

13

14 **Q. PLEASE REVIEW YOUR EDUCATIONAL BACKGROUND AND WORK
15 EXPERIENCE.**

16

17 A. I hold a Bachelor of Science, summa cum laude, in mathematics, awarded in 1962 by Xavier
18 University, Cincinnati, Ohio. I hold a Master of Science (1963) and Ph.D. (1965) in
19 mathematics awarded by the University of Chicago. I have served on the Faculty of Arts and
20 Sciences of Washington University since 1969. I have held a joint appointment in the Division
21 of Biostatistics since 1978. From 1965 to 1969, I was on the faculty of Northwestern
22 University.

23

24 **PURPOSE AND SCOPE**

25

26 **Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS CASE?**

27

28 A. I have been requested to examine weather-normalized predictions of water utilization made by
29 Dennis Patterson.

30

31 **Q. WHAT IS YOUR CONCLUSION?**

1 A. Mr. Patterson's prediction method is based on yearly utilization, while my method predicts
2 each month separately. Some small differences are to be expected, but one major difference
3 exists between his prediction and mine. That difference occurs for St. Louis District's
4 residential quarterly customers. Because of the large number of customers involved, even a
5 small difference in this estimate will have a large effect on ratemaking. As a result, Mr.
6 Patterson has overstated the level of revenues for the St. Louis District residential quarterly
7 customers by \$971,209.00 $[(292.05 \text{ gcd} - 287.86 \text{ gcd}) \times 365 \text{ days} \times 312.262 \text{ customers} \times$
8 $\$2.03337 \text{ per } 1,000 \text{ gallons}]$.

9
10 **Q. WHAT IS THE SOURCE OF THIS DISAGREEMENT?**

11
12 A. In 2002, St. Louis County Water Company acquired two local companies, Webster Groves and
13 Florissant. Customers of Webster Groves were billed in 2002 four times, for quarters ending
14 in March, June, September, and December. Their billed utilization represents a full year's
15 consumption. Florissant, however, was billed only three times, for quarters ending in April,
16 July, and October, so their billed utilization represents only nine months' consumption.

17
18 This causes no problem for prediction based on months, but it does cause a problem for
19 prediction based on years because utilization based on billing totals underestimates the actual
20 utilization in 2002, given the number of customers in 2002.

21
22 **Q. HOW DID MR. PATTERSON ADJUST FOR THIS UNDERESTIMATE?**

23
24 A. In his regression of total annual consumption on, Mr. Patterson inserted an indicator variable
25 (also called a "dummy" variable) that was equal to 1 for the year 2002 and equal to 0 for the
26 other nine years 1993-2001. His equation for gallons-per-customer-day consumption is:

27
$$\text{GCD} = 292.0487573 + 12.93244208 \cdot \text{DNSHORT} - 21.93414445 \cdot \text{DUMMY}$$

28 The variable DNSHORT is adjusted to equal 0 in a year of average shortfall of moisture.
29 Therefore, this equation predicts a normalized average consumption of 292.05 in every future
30 year. "Normalized" means under the assumption of average shortfall of moisture.

1 **Q. DOES IT ACCURATELY PREDICT UTILIZATION IN 2002?**

2

3 A. For 2002, Mr. Patterson calculated the value of DNSHORT to be 0.56437. Therefore, the
4 predicted GCD is $292.0487573 + 12.93244208 \cdot 0.56437 - 21.93414445 \cdot 1 = 277.41$. If we
5 multiply this by 365.25 days times 310435 customers in 2002, we obtain an estimated total
6 consumption of 31,454,517 thousands of gallons. To five significant figures this agrees with
7 the total consumption in 2002, which was 31,454,872 thousands of gallons, including the nine
8 months' Florissant consumption. That is not surprising because the dummy variable allows a
9 perfect match to the year 2002.

10

11 If the equation is reliable, by setting DUMMY equal to 0, we should also be able to use it to
12 estimate the actual consumption in 2002, including the missing quarter year's consumption of
13 the 14500 Florissant customers. For gallons-per-customer-day consumption, we have $GCD =$
14 $292.0487573 + 12.93244208 \cdot 0.56437 - 21.93414445 \cdot 0 = 299.35$. If we multiply this by 365.25
15 days times 310435 customers in 2002, we obtain an estimated total consumption of 33,941,923
16 thousands of gallons. The additional consumption of $33,941,923 - 31,454,517 = 2,486,563$
17 thousands of gallons would be due to 14500 Florissant customers over one quarter year, or
18 $365.25/4 = 91.3$ days. This works out to be $2,486,563,000/(14500 \cdot 91.3) = 1878.39$ GCD. The
19 details of this calculation are shown in Schedule ELS-1R. This is far too large. In fact, the
20 billing records for Florissant customers for the quarter ending in January 2003 (92 days)
21 indicate a quarterly utilization of 219,348,700 gallons, or $219,348,700/(14500 \cdot 92) = 164.43$
22 GCD, less than one-tenth the estimate from applying Mr. Patterson's model.

23

24 **Q. WHAT APPROACH WOULD BE BETTER?**

25

26 A. Rather than use a dummy variable for 2002, it would be better to add the Florissant utilization
27 billed for the quarter ending January 2003. It covers the last two months of 2002, and since
28 winter utilization is weather-insensitive, the portion of utilization from January 2003 should be
29 nearly the same as from January 2002. The 2002 utilization with this fourth quarter Florissant
30 utilization added in is $31,454,872 + 219,349 = 31,674,221$ thousands of gallons. The model
31 then becomes $GCD = 287.860851 + 9.24110302 \cdot \text{DNSHORT}$. The details of this calculation

1 are shown in Schedule ELS-2R. Since we project future utilization by using average weather
2 (DNSHORT = 0), the intercept term, 287.86 GCD, is the estimate of gallons-per-customer-day
3 consumption.
4

5 **Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

6
7 **A.** Yes, it does.
8

Illustration of Overestimated Consumption in Patterson Model

The data below, computed by Dennis Patterson:

YEAR	GCD	DNSHORT	DUMMY
1993	262.7571	-2.18583	0
1994	293.8470	0.13807	0
1995	282.0039	-0.82838	0
1996	284.5028	-0.95675	0
1997	287.2174	-0.15905	0
1998	270.9236	-1.59080	0
1999	294.5622	0.02134	0
2000	281.8458	-0.66038	0
2001	286.8267	-0.26983	0
2002	277.4133	0.56437	1

Leads to the regression model:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.974596885
R Square	0.949839087
Adjusted R Squ	0.935507398
Standard Error	2.494869145
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	2	825.0460541	412.523027	66.27544495	2.8267E-05
Residual	7	43.57060434	6.224372048		
Total	9	868.6166584			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	292.0487573	1.169979527	249.6186903	4.37204E-15	289.2821973	294.8153173
DNSHORT	12.93244208	1.140949364	11.33480809	9.31445E-06	10.23452747	15.63035668
DUMMY	-21.93414445	3.011259207	-7.284043965	0.000165011	-29.0546359	-14.813653

To predict overall GCD in 2002, including the missing quarter from Florissant:

$$292.0487573 + 12.93244208 \times 0.56437 = 299.3474295$$

Estimated total 2002 consumption, in 1000's of gallons:

$$299.3474295 \times 365.25 \times 310.435 = 33,941,923$$

Estimated Florissant consumption for the missing fourth quarter, in 1000's of gallons:

$$33,941,923 - 31454872.31 = 2,487,050$$

Estimated Florissant GCD for the missing fourth quarter:

$$2,487,050,207 / 14500 = 1878.39$$

Actual Florissant GCD for November 2002 to January 2003:

$$219,348,700 / 14500 = 164.43$$

Overestimate of GCD from the Patterson model:

$$1713.96$$

Correction of Overestimated Consumption in Patterson Model

The data below, computed by Dennis Patterson, except the 2002 GCD is modified to include the missing quarter from Florissant:

YEAR	GCD	DNSHORT
1993	262.7571	-2.18583
1994	293.8470	0.13807
1995	282.0039	-0.82838
1996	284.5028	-0.95675
1997	287.2174	-0.15905
1998	270.9236	-1.59080
1999	294.5622	0.02134
2000	281.8458	-0.66038
2001	286.8267	-0.26983
2002	279.3478	0.56437

Leads to the regression model:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.791998163
R Square	0.62726109
Adjusted R Squ	0.580668726
Standard Error	6.306088108
Observations	10

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	535.369559	535.369559	13.46274454	0.006317122
Residual	8	318.1339778	39.76674722		
Total	9	853.5035368			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	287.8608507	2.491025285	115.5591846	3.51436E-14	282.1165323	293.605169
DNSHORT	9.241103021	2.518587302	3.669161285	0.006317122	3.433226533	15.04897951

The weather-normalized estimate of gallons-per-customer-day (GCD) consumption is the intercept from the above regression: 287.86