Exhibit No.:
Issue: Cost-of-Service
Witness: Lissik
Type of Exhibit: Direct
Sponsoring Party: MoPSC Staff
Case No.: GR-93-172

MISSOURI PUBLIC SERVICE COMMISSION

POLICY & PLANNING DIVISION

DIRECT TESTIMONY

OF

EVE A. LISSIK

MISSOURI PUBLIC SERVICE,

A DIVISION OF UTILICORP UNITED, INC.

CASE NO. GR-93-172

Jefferson City, Missouri

May, 1993

DIRECT TESTIMONY

OF

EVE A. LISSIK

MISSOURI PUBLIC SERVICE,

A DIVISION OF UTILICORP UNITED, INC.

CASE NO. GR-93-172

Q. Please state your name and business address.

A. My name is Eve A. Lissik and my business address is Missouri Public Service Commission, P. O. Box 360, Jefferson City, Missouri.

Q. What is your present position with the Missouri Public Service Commission?

A. I am an Engineer in the Economic Analysis Department of the Policy and Planning Division.

Q. Would you please review your educational background and work experience?

A. I received a B.S. degree in Biology from Syracuse University and a Ph.D. in Agricultural Engineering from Cornell University. Prior to joining the Staff of the Missouri Public Service Commission, I was employed as an Assistant Professor of Agricultural Engineering at the University of Missouri.

Q. What is the purpose of your direct testimony?

A. The purpose of my direct testimony is to explain the procedures used for the development of

allocation factors for distribution mains and for services. The procedures for distribution mains are:

1. The development of the length related and demand related components for the cost of distribution mains;

2. The development of customer weights for each rate class allocated length and demand components of distribution mains;

3. The development of class allocation factors for the length related component of distribution mains;

4. The development of class allocation factors for the demand related component of the cost of distribution mains.

The procedures used to develop allocation factors for services are:

1. The development of a trended cost for all services listed in the property records for FERC Account #380: Services;

2. The direct assignment of service lines and their trended costs to each rate class.

LENGTH/DEMAND COMPONENTS OF DISTRIBUTION MAIN COSTS

Q. Why are costs associated with distribution main divided into a length component and a demand component?

A. The reason for this division is that a portion of costs do not vary with customer demand while the remainder of costs vary directly with capacity. For example, trenching costs vary only with the length of

distribution main installed independent of capacity and are therefore length related costs. However, distribution main is sized by diameter to meet customer demands; and therefore costs associated with distribution main size are demand related costs.

Q. Would you please explain the general method used to determine the length related component for the cost of distribution mains?

A. The zero intercept method is used to determine the length related component for the costs of distribution mains. In principle, the zero intercept method differentiates between those costs which vary with demand and those which do not. The term "zero intercept" comes from basic linear regression analysis and refers to the value of a linear equation when the independent variable is zero; i.e.,

$$y = f(x)\ mx + b$$

where

y = dependent variable,
x = independent variable,
f = functional relationship between y and x,
m = slope
b = intercept

When x = 0,

$$y = f(0) = m(0) + b = b$$

In cost allocations, the function f(x) is a cost function, y is the cost and x is a variable which describes distribution main size. Typically, y is the installed cost per unit length for main and x is the diameter of the pipe.

The zero intercept cost is the cost incurred independent of main size because diameter = 0.

Q. How do you measure the zero intercept costs?

A. As a part of our standard data request, the Staff asks the Company to provide a replacement cost study for distribution mains. Replacement costs are estimated by costing out the mains currently being installed and applying those costs to all existing distribution mains in the system. When replacement cost studies have been available, the Staff has used replacement costs per unit length to determine the zero intercept. Total installed replacement costs per unit length are estimated as a function of diameter and the zero intercept is the value of this estimated cost function at a diameter equal to zero. Multiplying the intercept by the total length of main gives the total amount of costs invariant of size.

Q. How are the zero intercept costs used to determine the customer and demand components of cost?

A. The zero intercept costs are divided by total replacement costs to give the percentage of cost going to the length component. The remaining percentage of cost is assigned to the demand component.

Q. Specifically, what data were provided by the Company in this case?

A. In response to Staff Data Request #4114, the Company provided a replacement cost study for FERC Account

#376: Distribution Mains, which included pipe diameter, installed length, and total installed cost for each type of distribution main in their system.

Q. How were these data used to determine the zero intercept cost of distribution mains?

A. Replacement costs per unit length for steel and plastic were averaged (Schedule 1), plotted against main diameter, and analyzed by means of a weighted linear regression. The weights used were percentage of length of each size of main in the system. The following equation minimized the weighted sum of the square of the errors

$$C = 0.6218\ D^{1.7831} + 7.89$$

where

C = cost per foot of distribution main

D = diameter of distribution main in inches

The above cost function has a zero intercept value of $7.89 per foot. The graph of this cost function is shown in Schedule 2.

Q. Why did you use a weighted linear regression?

A. The weighted linear regression equation is a better representation of the vast majority of installations which make up the total system costs, because all installations are not represented in equal numbers in the distribution system.

Q. How was the zero intercept value of $7.89 per foot used to determine the length related component of the allocation factors for distribution mains?

A. The zero intercept value for distribution main was multiplied by the total installed length to determine the level of installed costs which do not vary with diameter. The ratio of the total zero intercept costs to the total replacement costs for each diameter pipe (from the model equation presented above) gives the percentage of zero intercept costs for the system. For the Missouri Public Service distribution system 65.62% of the total distribution main costs are non-demand related costs. The results are shown in Schedule 3.

CUSTOMER WEIGHTS

Q. Please explain what is meant by a customer weight?

A. A customer weight is defined as the ratio of the average length of distribution main required to serve a customer in a particular class to the length of distribution main required to serve a customer in the smallest (in terms of land area) rate class. It is calculated as follows:

$$W_i = \left(\frac{A_i}{A_{min}}\right)^{0.5}$$

where

W_i = customer weight for class i

A_i = average area per parcel for a customer in class i

A_{min} = average area per parcel for a customer in the class with the smallest average area

Q. Please explain where the data were obtained for the Staff's customer density study?

A. Typically, the Staff tries to obtain complete property records for all residential, commercial and industrial properties from all counties served by the Company. When those data are unavailable, the Staff uses available sampled data from counties and communities of size similar to those served by the Company. For this case, not all of the counties served by the Company were able to provide any property records for residential or commercial properties. Also, not all of the counties were able to provide complete detailed information on properties of customers in the large volume class. The county offices that provided these data for residential, commercial and large volume classes were:

1. Office of the Assessor, Henry County
2. Office of the Assessor, Chariton County
3. Office of the Assessor, Grundy County
4. Office of the Assessor, Johnson County
5. Office of the Assessor, Pettis County
6. Office of the Assessor, Platte County
7. Office of the Assessor, Saline County

Q. In the absence of complete property records for residential or commercial customers served by the Company how were similar, available data utilized to obtain

average parcel area for the residential and commercial rate classes?

A. Area per parcel, in terms of acre per parcel was calculated for each residential and commercial property in the Staff's data base. Average acreage per class was calculated by the following formula:

$$\overline{A}_R = \Sigma(A_{RC} \times P_{RC})/\Sigma(P_{RC})$$

where

$\overline{A}_R$ = average acres/parcel for rate class R

A_{RC} = acres/parcel for rate class R in community C

P_{RC} = the parcels in rate class R for community C

R = rate class

C = community

The results are given in Schedule 4.

Q. Is this the best method for calculating average acres per parcel?

A. No. But it is the simplest. Basically the method above does a simple average of each residential or commercial property in the Staff data base. There is no apparent functional relationship between acres per parcel and community size for any community in the Staff files, so it is impossible to estimate parcel sizes for communities served by the Company.

Q. How was the average area for the large volume class derived?

A. The Company provided the names of all large volume customers. Of the 32 large volume customers, parcel areas associated with 17 of them were found from the county tax rolls. These parcels were averaged together to give an estimated parcel size for this class. The result is shown in Schedule 5.

Q. How were customer weights derived from the average parcel areas?

A. From the results in Schedules 4 and 5, average parcel size for residential, commercial and large volume customers were calculated by simple averages. Customer weights were calculated by taking the square root of the ratio of average parcel size for each class to the average parcel size of the smallest (in terms of area) class. Because the commercial weight includes large parcels from St. Louis County, this weight was assigned to the medium general service class. The weight for the small general service class was obtained by taking a simple average of the weights derived for the residential and medium general service class. Customer weights are presented in Schedule 6.

DISTRIBUTION MAIN ALLOCATORS

Q. What allocation factors are developed for distribution mains in this case?

A. Specifically, two sets of allocation factors are developed for distribution main. Length allocators and demand allocators are developed for the four separate classes: residential, small general service, medium general service and large volume service.

Q. How is the customer portion of distribution main costs allocated?

A. I have previously discussed the zero intercept method used to differentiate between those costs which vary with the volume of gas delivered (demand related costs) and those which do not (length related costs). The length related portion of mains is allocated using weighted numbers of customers where the weights are proportional average length of main needed to serve a customer in a particular rate class. The length allocators for each rate class are given in Schedule 7. The customer numbers were developed from the Company's billing data for the test year ending September 30, 1992, adjusted for annualized customers. The customer weights were developed in the previous section.

Q. How did you determine each class share of monthly peak day demand costs?

A. First, the length of distribution main required to serve each rate class is calculated from total length of main in the entire distribution system and weighted customer numbers. Next the peak day demand per unit length is calculated for each class for each month. The demand per unit length is then raised to the power 0.6687 to account for economies of scale. Then scaled demands per unit length are multiplied by the length of main serving each class to obtain the relative demand costs for each class. Finally the percentage of relative capacity costs are calculated for each class. The monthly demand allocators are presented in Schedule 8.

Q. Please explain the source of the scale factor 0.6687?

A. Recall that pipe costs vary directly with pipe diameter raised to the 1.7831 power. Empirically, the volume of gas a pipe can carry varies as the diameter raised to the 0.375 power. Therefore, demand costs vary with the 0.6687 (=1.7831 x 0.375) power of capacity.

Q. How did you obtain the coincident peak demand data?

A. Monthly peak demands for residential and small general service classes were obtained from a regression analysis of the weather sensitivity performed by Staff witness James Gray. Peak day demands were estimated by using each month's coldest normal day as the weather

value. Coincident peak demands for the medium general service and large volume service classes were obtained from Staff witness Anne Ross.

Q. How does scaling the demand per unit length account for economies of scale?

A. Each class is conceptually being served from a distribution system of standardized length. To determine the relative capacity and thus size of the pipe required to serve each class, the class demands are divided by length and then raised to the 0.6687 power to reflect the differences in the demand related costs.

Q. Do the demand allocators vary with standardized length?

A. No, they do not. It can be shown algebraically that the relative demand costs for each class are independent of the standardized length assumed for each system.

TRENDED COST STUDY FOR SERVICES

Q. What data were provided by the Company for FERC Account #380: Services?

A. In response to Staff Data Request #4109, the Company provided updated property records for FERC Account #380: Services, which included pipe diameter, year of installation, total installed cost and number of installations for each service in the distribution system.

Q. How were these data used to estimate the trended costs for services.

A. Trended costs for services were calculated by multiplying each component of installed cost by the appropriate factor derived from the Handy-Whitman Index. The object of trending costs is to eliminate any differences caused by the escalation of costs which have occurred over time. The results of the trended cost study are given in Schedule 9.

ASSIGNMENT OF SERVICE LINES TO EACH RATE CLASS

Q. How are services assigned to each rate class?

A. The total number of complete services (1 service = 1 extension + 1 stub) were adjusted to match the total number of annualized customers for the Missouri Public Service system. These services were then directly assigned to the residential, small general service, medium general service, and large volume service classes by service diameter and classes' peak demand. The smallest diameter services went to the residential class, the next smallest to the small general service class, etc., until all services were assigned. The assignment of services and their corresponding costs are presented in Schedule 10.

Q. How are the allocation factors for each rate class determined?

A. The allocation factors for services for the residential, small general service, medium general service,

and large volume service classes are the proportion of total trended costs assigned to them.

Q. Does this conclude your direct testimony?

A. Yes, it does.

BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

In the matter of Missouri Public Service tariff sheets designed to increase rates for gas service provided to customers in the Missouri service area of the company.	))))	CASE NO. GR-93-172

AFFIDAVIT OF EVE A. LISSIK

STATE OF MISSOURI)
) ss
COUNTY OF COLE)

Eve A. Lissik, of lawful age, on her oath states: that she has participated in the preparation of the foregoing written testimony in question and answer form, consisting of 14 pages of testimony to be presented in the above case, that the answers in the attached written testimony were given by her; that she has knowledge of the matters set forth in such answers; and that such matters are true to the best of her knowledge and belief.

Eve A. Lissik

Subscribed and sworn to before me this 27th day of May, 1993.

Judy Fritsch
Notary Public

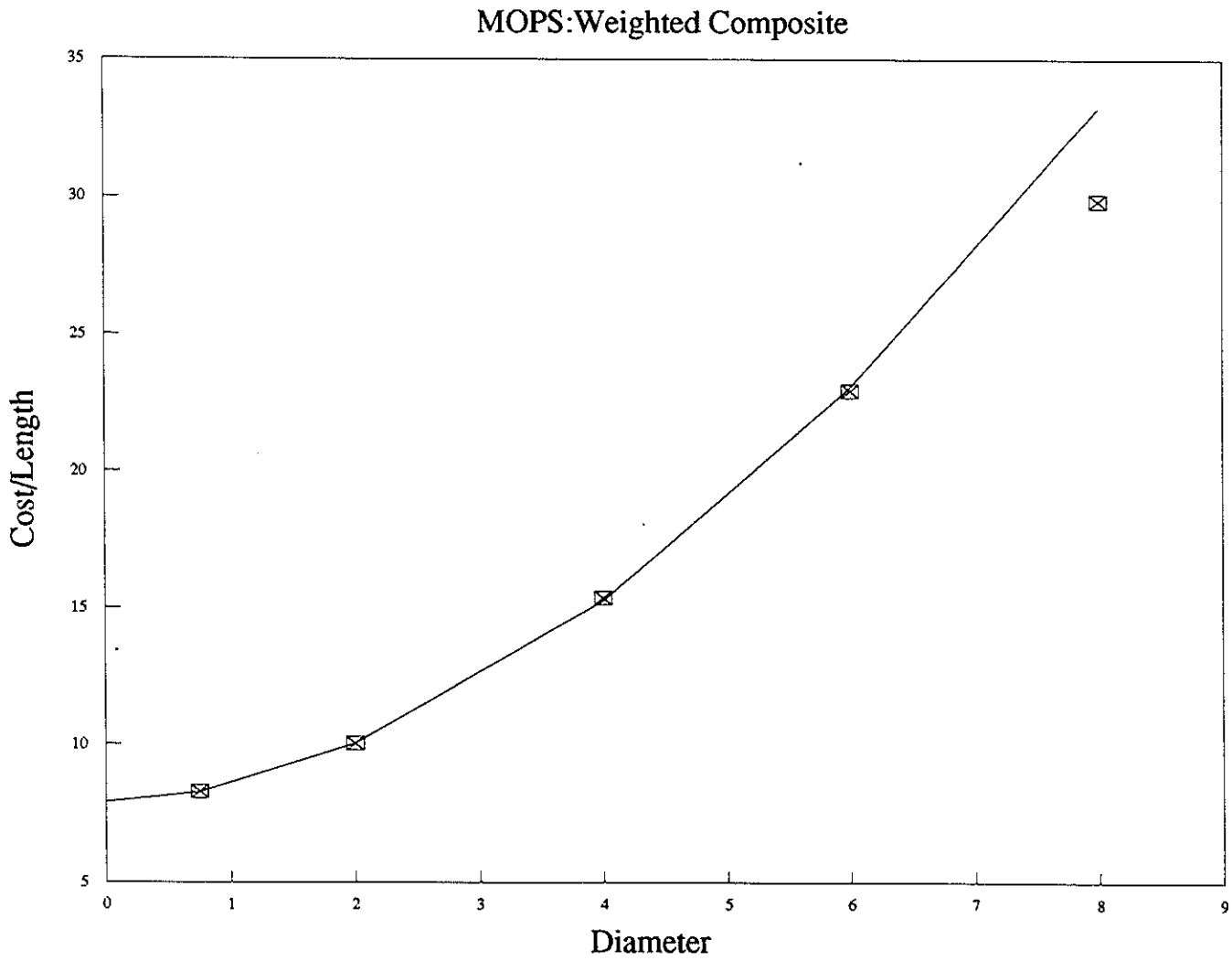
JUDY FRITSCH
NOTARY PUBLIC STATE OF MISSOURI
COLE COUNTY
MY COMMISSION EXP AUG. 15,1993

My commission expires

Composite Costs:

Diameter	Plastic Length	Steel Length	Plastic Cost per Length	Steel Cost per Length	Composite Cost per Length
0.00					
0.75	11,387		$8.28		$8.28
2.00	1,400,900	949,290	$8.26	$12.63	$10.03
4.00	416,376	272,362	$13.52	$18.17	$15.36
6.00	64,704	120,366	$17.26	$25.98	$22.93
8.00		21,694		$29.84	$29.84
	1,893,367	1,363,712			

Schedule 1


MOPS:Weighted Composite
Cost/Length
Diameter
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9

Schedule 2

Diameter	Composite Cost	Composite Length	Total Composite Cost	Zero Intercept Cost
0.00	7.89			
0.75	8.26	11387	$94,083	$89,843
2.00	10.03	2350190	$23,572,448	$18,542,999
4.00	15.26	688738	$10,506,853	$5,434,143
6.00	23.07	185070	$4,268,942	$1,460,202
8.00	33.24	21694	$721,079	$171,166
			$39,163,405	$25,698,353
		Length Component:		0.6562

Schedule 3

		RESIDENTIAL			COMMERCIAL		
Community	Population	Total Area	# Parcels	Area/ Parcel	Total Area	# Parcels	Area/ Parcel
Passaic	53	26.03	40	0.65	1.72	10	0.17
Millersville	125	35.11	39	0.90	1.85	2	0.93
Amoret	238	65.96	100	0.66	15.99	40	0.40
Oak Ridge	252	91.38	84	1.09	1.97	7	0.28
Gordonville	267	147.36	140	1.05	10.32	12	0.86
Tracy	310	2.54	117	0.02	5.20	9	0.58
Leeton	604	118.94	314	0.38	12.91	30	0.43
Arcadia	683	110.54	321	0.34	27.68	27	1.03
Keytesville	689	106.78	281	0.38	76.68	73	1.05
Archie	753	172.64	414	0.42	23.72	51	0.47
Brunswick	1272	90.95	535	0.17	127.53	171	0.75
La Plata	1423	102.85	700	0.15	NA	NA	NA
Weston	1440	615.02	633	0.97	24.61	71	0.35
Adrian	1484	417.88	590	0.71	105.22	160	0.66
Ironton	1743	172.56	928	0.19	117.36	158	0.74
Salisbury	1975	51.60	860	0.06	69.47	154	0.45
Platte City	2144	138.60	924	0.15	91.43	127	0.72
Butler	4107	82.19	160	0.51	37.53	47	0.80
Trenton	6811	NA	NA	NA	732.24	339	2.16
Jackson	7827	1345.51	3223	0.42	214.16	253	0.85
Clinton	8366	1094.12	3218	0.34	189.52	412	0.46
Buchanan County	83083	6730.37	30593	0.22	641.64	2674	0.24
St. Louis	452801	13825.40	122457	0.11	7545.50	14261	0.53
St. Louis County	973896	45148.46	112970	0.40	116297.98	28052	4.15
		70692.79	279641	0.25	126372.23	47140	2.68
WEIGHT:				1.00			3.26

Schedule 4

LARGE VOLUME SERVICE:

#	Customer	Area
1	**********	99.10
2	**********	63.40
3	**********	33.90
4	**********	
5	**********	34.60
6	**********	
7	**********	
8	**********	
9	**********	
10	**********	
11	**********	
12	**********	
13	**********	
14	**********	49.00
15	**********	24.70
16	**********	30.00
17	**********	
18	**********	124.40
19	**********	3.60
20	**********	7.00
21	**********	11.00
22	**********	1.90
23	**********	26.50
24	**********	
25	**********	209.10
26	**********	
27	**********	44.40
28	**********	9.20
29	**********	
30	**********	
31	**********	
32	**********	25.50
	AVERAGE:	46.90
	WEIGHT:	13.62

Class	Average Parcel Area	Class Weight
Residential	0.25 acres	1.00
Small General Service	Not Available	2.13
Medium General Service	2.68 acres	3.26
Large Volume	46.90 acres	13.62

Length Component: 0.6562

Class	Weight	Customers	Weighted Customers	Percent	Allocator
Residential	1.00	36071	36071	0.7773	0.5101
Small General Service	2.13	4360	9286.8	0.2001	0.1313
Medium General Service	3.26	187	609.62	0.0131	0.0086
Large Volume Service	13.62	32	435.84	0.0094	0.0062
Totals		40650	46403.26	1.0000	0.6562

Schedule 7

Demand Component: 0.3438

Class	Weight	Customers	Peak Demands	Demand/ Customer	Demand/ Weighted Customer	Scaled Demand	Relative Share of Capacity	Percent	Allocator
Residential	1.00	36071	36965	1.0248	1.0248	1.0165	36666	0.6667	0.2292
Small General Service	2.13	4360	10670	2.4472	1.1489	1.0973	10190	0.1853	0.0637
Medium General Service	3.26	187	6065	32.4332	9.9488	4.6470	2833	0.0515	0.0177
Large Volume Service	13.62	32	18316	572.3750	42.0246	12.1780	5308	0.0965	0.0332
		40650	72016				54997	1.0000	0.3438

Schedule 8

Trended Cost Study:

Diameter	Stub	Extension	Services	Adjusted Services	Stub Embedded Cost	Extension Embedded Cost	Service Embedded Cost	Stub Trended Cost	Extension Trended Cost	Service Trended Cost
0.500	20985	21666	20985	21091	$3,064,582.77	$7,476,851.68	$10,541,434.45	$3,618,155.30	$8,852,280.73	$12,470,436.03
0.625	7	4	4	4	$382.49	$293.10	$675.59	$2,412.95	$1,739.70	$4,152.65
0.750	5484	7621	5484	5512	$816,976.78	$2,219,053.20	$3,036,029.98	$1,566,460.13	$4,060,218.40	$5,626,678.53
1.000	9106	12367	9106	9152	$604,524.69	$1,636,650.59	$2,241,175.28	$2,448,158.14	$5,778,390.12	$8,226,548.26
1.250	3514	7307	3514	3532	$307,969.58	$1,084,403.76	$1,392,373.34	$1,503,651.91	$4,919,612.22	$6,423,264.13
1.500	21	234	21	21	$2,243.60	$13,689.34	$15,932.94	$12,208.15	$143,977.16	$156,185.31
2.000	2637	1266	1266	1272	$1,378,957.00	$290,868.97	$1,669,825.97	$409,645.80	$879,983.50	$1,289,629.30
2.250	5	8	5	5	$790.75	$138.80	$929.55	$4,131.56	$9,955.80	$14,087.36
2.500	3	0	0	0	$1,877.29	$0.00	$1,877.29	$2,299.21	$0.00	$2,299.21
3.000	7	0	0	0	$1,057.59	$0.00	$1,057.59	$13,093.68	$0.00	$13,093.68
4.000	57	77	57	57	$11,076.20	$20,655.85	$31,732.05	$26,942.91	$67,585.17	$94,528.08
5.000	2	2	2	2	$157.90	$1,789.35	$1,947.25	$209.73	$8,317.92	$8,527.65
6.000	1	2	1	1	$251.09	$7,305.32	$7,556.41	$1,333.48	$25,888.69	$27,222.17
8.000	0	1	0	0	$0.00	$779.63	$779.63	$0.00	$3,550.57	$3,550.57
	41829	50555	40445	40650	$6,190,847.73	$12,752,479.59	$18,943,327.32	$9,608,702.95	$24,751,499.98	$34,360,202.93

Schedule 9

Diameter	Adjusted Services	Residential	Small General Service	Medium General Service	Large Volume Service	Residential	Small General Service	Medium General Service	Large Volume Service	Service Trended Cost
0.500	21091	21091	0	0	0	$12,470,436.03	$0.00	$0.00	$0.00	$12,470,436.03
0.625	4	4	0	0	0	$4,152.65	$0.00	$0.00	$0.00	$4,152.65
0.750	5512	5512	0	0	0	$5,626,678.53	$0.00	$0.00	$0.00	$5,626,678.53
1.000	9152	9152	0	0	0	$8,226,548.26	$0.00	$0.00	$0.00	$8,226,548.26
1.250	3532	312	3220	0	0	$567,400.46	$5,855,863.67	$0.00	$0.00	$6,423,264.13
1.500	21	0	21	0	0	$0.00	$156,185.31	$0.00	$0.00	$156,185.31
2.000	1272	0	1119	154	0	$0.00	$1,133,617.59	$156,011.71	$0.00	$1,289,629.30
2.250	5	0	0	5	0	$0.00	$0.00	$14,087.36	$0.00	$14,087.36
2.500	0	0	0	0	0	$0.00	$0.00	$2,299.21	$0.00	$2,299.21
3.000	0	0	0	0	0	$0.00	$0.00	$13,093.68	$0.00	$13,093.68
4.000	57	0	0	28	29	$0.00	$0.00	$46,434.85	$48,093.23	$94,528.08
5.000	2	0	0	0	2	$0.00	$0.00	$0.00	$8,527.65	$8,527.65
6.000	1	0	0	0	1	$0.00	$0.00	$0.00	$27,222.17	$27,222.17
8.000	1	0	0	0	0	$0.00	$0.00	$0.00	$3,550.57	$3,550.57
	40650	36071	4360	187	32	$26,895,215.93	$7,145,666.57	$231,926.81	$87,393.62	$34,360,202.93
				ALLOCATION FACTORS:		0.7827	0.2080	0.0067	0.0025	1.0000

Schedule 10