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BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

PREPARED DIRECT TESTIMONY OF YAPING WANG

ON BEHALF OF ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

DOCKET NO. 930256-WS

JULY 1994

Q1. Please state your name, business and occupation.

A1. My name is Yaping Wang. I am a resource economist with the St. Johns River Water Management District.

Q2. Please describe your position with your employer and your duties and responsibilities in that position.

A2. I have been with the District as a resource economist since April, 1989. My duties include preparing the Economic Impact Statement (EIS) as part of the rule-making process, and a wide range of economic studies concerning land acquisition, wastewater reuse, and water conservation.

Q3. Please summarize your education and work background.

A3. Exhibit 1 is my resume of education and work background.

Q4. What is the purpose of your testimony?

A4. In general, my testimony will explain the effect an inverted rate structure has upon water consumption by a customer of a water utility company. In particular, I will explain the effect that the inverted rate structure, as proposed by Sanlando Utilities, has on water consumption.

Q5. Please explain the effect upon water consumption that an inverted rate structure is intended to have.

A5. The law of demand in economic theory states that as the price of a commodity increases, the demand for that commodity decreases. Price elasticity is the measure of the change in quantity demanded caused by the change in price. The demand for a commodity can be elastic or inelastic. An elastic demand is the one that has a greater percentage change in demand than in price. An inelastic demand is one that has a lower percentage change in demand than in price. Discretionary uses such as irrigation and car washing are relatively elastic demands because they are the most sensitive to changes in water rates.

By incorporating a per unit charge that increases with an incremental change in water use, an inverted rate structure intends to discourage discretionary water uses. An inverted rate structure generally has no effect on potable water uses, such as drinking, cooking and bathing, since these uses are relatively insensitive to rate changes and are priced at a lower rate. Therefore, reduction in water consumption by an inverted rate structure is mainly experienced in the areas of the larger users and discretionary uses. In the case of Sanlando, the larger users are those who use more than 10,000 gallons per month.

Q6. Please explain the variables that would affect the conservation that would result from an inverted rate structure.

A6. Variables which would have a certain impact on the effectiveness of an inverted rate structure are price elasticity, block rate pricing, block threshold, customer classification, duration and communication.

Q7. Please explain price elasticity and relate that to the Sanlando Utilities' service area.

A7. Individual customers' demand for water can be either elastic or relatively inelastic depending on price level. A study done in southwest Florida has shown that at prices below $1.00 per 1,000 gallons or above $6.00 per 1,000 gallons, the demand for water was relatively inelastic regardless of wealth. In addition, price elasticity is different among different wealth groups. The same study suggested that less wealthy customers are more price elastic at $1.50, whereas wealthy customers are more price elastic at $3.00.

In the Sanlando service area, the price is relatively inelastic due to the wealth of the customers as determined by the property values and the current low water price of 35.5 cents per 1,000 gallons. Therefore, it is not expected that water consumption will be significantly reduced under the proposed inverted rate structure because the existing rates are so low when compared with the model.

Q8. Please explain block rate pricing and relate that to the Sanlando Utilities' service area.

A8. In block rate pricing, the price of the second block needs to be sufficiently higher than the price of the first block so that customers have an economic incentive to conserve water. As a guideline, the price of the second block should be at least 25 percent greater than the price of the first block.

In the Sanlando proposal, the first block is $0.355 and the second block is $0.50. Therefore, the second block is over 25 percent, actually 40 percent, greater than the first and there should be an economic incentive to reduce consumption over the 10,000 gallons. Similarly, the price of the third block, $0.65, is over 25 percent greater than the price of the second block ($0.50) so there should be a conservation effect. The price of the fourth block, $0.85, is over 25 percent greater than the third block ($0.65) so again there should be a conservation effect.

Q9. Please explain the block threshold and relate that to the Sanlando Utilities' service area.

A9. The threshold between the first and second blocks for a given customer classification should take into account the amount of potable water use plus a reasonable amount of discretionary water use and the average water usage for that customer classification. For example, if the average monthly single-family customer water use in a community is 10,000 gallons and the block threshold for the second block is 30,000 gallons, single-family customer water use will not be largely affected by the block rate. As a result, water consumption by the single-family will be minimally reduced because the threshold was too high and the users are not affected by the increased rate. By contrast, if the second block is set at 5,000 gallons for the same community, the customers' discretionary uses will be affected by this block rate but with no ability to further reduce their consumption. Therefore, thresholds that are too low can generate excess revenues because consumption is not reduced where the rate is increased. The major task for the utility is to set meaningful block thresholds that will discourage excessive discretionary water use without generating excess revenues.

With regard to Sanlando, the proposed block thresholds are acceptable at 0 to 10,000, 10,000 to 20,001, 20,001 to 30,000 gallons, and over 30,000. According to Exhibit II of the Petition, 63% of the single-family customers are affected by the block thresholds. This is an acceptable result for block thresholds which should discourage discretionary uses.

In the Sanlando Utilities' service area, however, over 40% of the single-family customers are using more than 20,000 gallons a month. This is considered high water consumption pattern when compared with the ten utilities involved in the computer model. Due to low water rates and high water consumption by a large portion of its customers, Sanlando Utilities may generate more excess revenue than it projected under the proposed block thresholds. This situation can be mitigated by adopting a higher block threshold to reduce excess revenue.

Q10. Please explain customer classification and relate that to Sanlando Utilities' service area.

A10. There should be different block thresholds for each customer classification, such as single-family residential, commercial and industrial, and irrigation, because different classifications have different uses of water. For example, if the first block is designed based on a monthly average single-family residential water usage of 10,000 gallons, it would be unlikely that the rate would have any effect on water consumption of a commercial customer such as a 300 unit hotel.

With regard to Sanlando, there are four blocks. Exhibit 1 to the plan shows the customer usage for residential, general service, multi-family, and bulk sales. The four proposed blocks coincide with the different customer classifications with the over 30,000 block appearing to have the most significant effect.

The largest block, over 30,000, would include the majority of the general service, multi-family and bulk sales users according to Exhibit 1. With the inverted rate structure, the rate for the over 30,000 gallons users increases to $0.85 per 1,000 gallons. Therefore, there would be an incentive to conserve water for those users.

The residential consumption is distributed over the four block thresholds. For the users over 10,000, there is a conservation effect and the effect increases with each block.

Q11. Please explain the duration variable and relate that to the Sanlando Utilities' service area.

A11. Like other water conservation rate structures, an inverted rate structure is effective in the short term, but it tends to diminish over time because consumers become accustomed to the new rate structure and because the real price falls over time. Therefore, the inverted rate needs regular monitoring and updating to be effective over the long term.

The Sanlando proposal is for four years to fund the reuse project. After four years, it would be wise to review the rates and usage for possible continuation.

Q12. Please explain the variable of communication and relate that to the Sanlando Utilities' service area.

A12. Water conservation by the inverted rate structure will be maximized if the utility has communicated this rate to its customers frequently. Customers need to be informed about the price of water and how much they have used so that they can respond to the pricing signal and use water efficiently. Better communication to customers can be achieved through clear documentation of water rates, historic and current water use on water bill and the water use should be presented in gallons per day. Additionally, billing frequency should be monthly or, at least, bimonthly as opposed to quarterly.

Q13. Please explain the overall effect of an inverted rate structure upon water consumption and consequent reduced water withdrawals from the aquifer.

A13. The inverted rate structure is the most well known of the conservation rate structures, and it has been used by many utilities in Florida and throughout the U.S. An inverted rate structure may affect customers, the utility, and the water resources of the state. The overall effect of an inverted rate structure, if properly designed, would primarily reduce customers' discretionary uses such as irrigation and car washing. At a high enough price, demands for potable uses may also be reduced. However, demand for potable uses are relatively inelastic to small or moderate changes in rates because these uses are essential to an accepted lifestyle.

As the demand for water is reduced, the utility may be able to delay plant or wellfield expansion. The delay in plant or wellfield expansion can be translated to cost savings to the utility and its customers as well.

If an inverted rate structure can reduce water consumption, the withdrawals from the aquifer or other sources can also be reduced. This is especially beneficial in an area which has experienced, or may experience in the future, water shortage problems or in an area of water quality concerns.

Q14. How do you determine the effect that an inverted rate structure has upon water consumption?

A14. There is a computer model designed by and a methodology as presented in Definition of Water Conservation Promoting Rates, Feb.1993, Water Price Elasticity Study, August 1993, and Water Conservation Promoting Rate Structure Computer Model, September 1993. These reports were prepared by Brown and Caldwell in cooperation with the Southwest Florida Water Management District.

Q15. How does the model work?

A15. Given the water usage at the existing rates and the proposed blocks and rates for each block, the model will give an average percent of overall consumption reduction.

Q16. Have you had the opportunity to review the Proposed Water Reuse Program First Amendment Dated 1/31/93 Sanlando Utilities Corporation which was attached to the petition filed by Sanlando Utilities Corporation in this case?

A16. Yes.

Q17. If put into effect, what will be the conservation effect of the rate structure that Sanlando Utilities Corporation has included in its petition?

A17. Using the computer model, it is estimated that total water consumption of Sanlando Utilities would be reduced by 4.6 percent if the proposed inverted rate structure is adopted. This is an average reduction of all four blocks.

Q18. How does each block contribute to the 4.6 percent?

A18. Since the 4.6 percent reduction reflects the combined effect of the four blocks and rates, the contribution for each block is determined by modeling each rate across the board for all consumption. The model is run three separate times to determine the contribution for each block rate. It is estimated that a rate of $0.50 per 1,000 gallons would reduce total water use by 3.0 percent, $0.65 per 1,000 gallons by 5.4 percent, and $0.85 per 1,000 gallons by 8.5 percent.

Q19. Is the 4.6 higher or lower than that estimated by Sanlando Utilities?

A19. Sanlando estimated a total water consumption of 9.7 percent. The lower reduction rate estimated by the District is due to the use of the model which is affected by the relatively high percentage of "wealthy" customers within its service area and relatively low water price even after the inverted rate structure is implemented.

The customer base is categorized as wealthy based on the variables defined by the model. One variable in determining wealth is the home value in the area as determined from census data. In the customer service area of Sanlando, over 80% of the homes are valued over 81,000. Therefore, the increased rate will not have as large an effect as it would if the increased rate were imposed on a service area with homes of a lesser value.

Q20. What would the inverted rates for each block be if the overall reduction is 10% as proposed by Sanlando Utilities? Please explain how you determined this.

A20. The overall reduction of 10% can be determined using the same computer model. The model consists of three modules, including the Bill Frequency Module, the Price Impact Module, and the Revenue and Water Use Impact Module, which together determine the impact on water use and revenues of the proposed rates. If the results are not acceptable at the 4.6 percent reduction level the user can explore other options by changing the proposed water rates in the Price Impact Module until a rate structure is found that both derives necessary revenues and achieve the desired level of water use reduction. However, this would be difficult in certain circumstances where water rates are so low and/or customers' income is so high that price elasticity of water tends to become very low.

In the Sanlando case, a 10 percent reduction can be achieved by increasing the third and fourth block rates to $1.10 and $2.20 per 1,000 gallons, respectively, for residential customers, while charging a flat rate of $0.75 per 1,000 gallons at the third and fourth blocks for multi-family, and commercial and industrial users. Exhibit 2 shows this alternative. The lower charge for multi-family, and commercial and industrial users takes into account the effect of the lower price elasticity of these customers. If all customer classes were charged at the same block rate, more excess revenue will be generated at the same water reduction level. Exhibit 3 showa this alternative. Still, both alternative rates generate more excess revenue than that by the proposed rates.

Q21. Please summarize your testimony.

A21. The inverted rate structure is the most well known of the conservation prompting rate structures, and it has been used by many utilities in Florida and throughout the U.S. By incorporating a per unit charge that increases with incremental change in water use, an inverted rate structure intends to discourage discretionary uses such as irrigation and car washing. At a high enough price, demands for potable uses may also be reduced.

Adopting an inverted rate structure does not guarantee reduction in water consumption. Among many variables that would affect the effectiveness of an inverted rate structure, price elasticity is the key variable to determine the reduction level of different customer groups.

If Sanlando Utilities' proposed inverted rate structure is adopted, it is estimated that total water consumption of Sanlando Utilities would be reduced by 4.6 percent. The low reduction rate is due primarily to relatively high percentage of wealthy customers within its service area and relatively low water price of Sanlando Utilities.

Q22. Does this conclude your testimony?

A22. Yes.

YAPING WANG, AICP
Resource Economist
St. Johns River Water Management District

Areas of Specialization

Economic impact statement, wastewater reuse, leak detection, rate structure, alternative water use, water conservation, comprehensive planning, cost/benefit analysis, socio-economic and population studies.

Education

1989	M.S., Urban Planning, University of Wisconsin-Milwaukee
1982	B.A., Architecture, Tong Ji University, China

Professional Experience

1989-Present	Resource Economist, St. Johns River Water Management District. Prepared all the economic impact analysis (EIS) for the District as part of rule-making process. Conducted a wide range of economic studies concerning land acquisition, wastewater reuse, and water conservation.
1987-1989	Consultant, SRI International Assessed economic development opportunities for Saginaw, Michigan, State of Nebraska, Iowa, and North Dakota. Conducted statistical analysis on factors attributed to regional productivity difference.
1986-1988	Research Assistant, University of Wisconsin-Milwaukee Provided statistical analysis for various research project. Conducted surveys on education programs among state planners. Taught graduate students computer applications.
1984-1985	Research Analyst, Shanghai Investment and Trust Corp., China Identified and assessed business opportunities for foreign companies in real estate development projects. Conducted feasibility studies for hotel and condominium development.
1982-1984	Architect, Shanghai Architectural Design Institute, China Selected and planned sites for residential, institutional and commercial development. Designed apartment buildings and commercial complex.

10/o reduction

Alt ①

Table 4 INPUT Water Rates by Customer Class: By Water Rate Block

Rates/Customer Class	Water Rate Block Ranges, kgal (a) Beginning	Ending	Water Rates: Last Year's Rates	Existing Rates	Proposed Rates
QUANTITY CHARGE,$/kgal (b)					
Single Family					
Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.30
Block 3	10	20	0.35	0.36	0.55
Block 4	20	30	0.35	0.36	1.10
Block 5	30	100	0.35	0.36	2.20
Off Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.30
Block 3	10	20	0.35	0.36	0.55
Block 4	20	30	0.35	0.36	1.10
Block 5	30	100	0.35	0.36	2.20
Multiple Family					
Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.30
Block 3	10	20	0.35	0.36	0.55
Block 4	20	30	0.35	0.36	0.75
Block 5	30	100	0.35	0.36	0.75
Off Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.30
Block 3	10	20	0.35	0.36	0.55
Block 4	20	30	0.35	0.36	0.75
Block 5	30	100	0.35	0.36	0.75
Commercial					
Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.30
Block 3	10	20	0.35	0.36	0.55
Block 4	20	30	0.35	0.36	0.75
Block 5	30	100	0.35	0.36	0.75
Off Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.30
Block 3	10	20	0.35	0.36	0.55
Block 4	20	30	0.35	0.36	0.75
Block 5	30	100	0.35	0.36	0.75
Industrial					
Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.30
Block 3	10	20	0.35	0.36	0.55
Block 4	20	30	0.35	0.36	0.75
Block 5	30	100	0.35	0.36	0.75
Off Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.30
Block 3	10	20	0.35	0.36	0.55
Block 4	20	30	0.35	0.36	0.75
Block 5	30	100	0.35	0.36	0.75

Table 22 OUTPUT Projected Water Use Change by Customer Class, kgal

Customer Class	Water Use Change, percent(a)	Projected Annual Water Use, kgal (b)	Water Use Change, kgal (c)	Net Projected Annual Water Use, kgal (d)
Single Family	-12.46%	2,449,924	(305,320)	2,144,604
Multiple Family	0.00%	171,245	0	171,245
Commercial	-1.68%	312,462	(5,242)	307,220
Industrial	-2.15%	159,952	(3,440)	156,512
Total	-10.15%	3,093,583	(314,002)	2,779,581

(a)From Table 16 in Price Impact Module.
(b)From Table 20.
(c)Water use change percent times projected water use.
(d)Projected water use plus water use change.

Table 23 OUTPUT Revenue Impact by Rate Component and Customer Class

Description	Projected Revenue
Revenue Generated With Proposed Rates (a)	
Service Charge	
Meter Independent	0
Meter Dependent	795,992
Subtotal, Service Charge	795,992
Quantity Charge	
Single Family	2,090,553
Multiple Family	115,239
Commercial	210,643
Industrial	117,172
Subtotal, Quantity Charge	2,533,607
Total Revenue Generated	3,329,599
Revenue Requirements (b)	
Service Charge	
Meter Independent	797,416
Meter Dependent	0
Subtotal, Service Charge	797,416
Quantity Charge	
Existing Revenue Requirement	1,098,222
Change in Revenue Requirement (variable costs)	(11,147)
Subtotal, Quantity Charge	1,087,075
Total Revenue Requirement	1,884,491
Revenue Surplus (Shortfall)	1,445,108

(a) Calculated using Net Projected Water Use from Table 22, proposed weighted water rates from Table 10, and service charges from Table 5 in Price Impact Module. Accounts and equivalent accounts from Table 17 and 19, respectively.

(b) Projected revenue requirements from existing rates from Table 21 adjusted for change in variable costs. The variable cost percent of quantity charge revenue requirements can be adjusted in cell F9.

10% reduction
Alt (2)

Table 4 INPUT Water Rates by Customer Class: By Water Rate Block

Rates/Customer Class	Water Rate Block Ranges, kgal (a) Beginning	Ending	Water Rates Last Year's Rates	Existing Rates	Proposed Rates
QUANTITY CHARGE,$/kgal (b)					
Single Family					
Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.36
Block 3	10	20	0.35	0.36	0.50
Block 4	20	30	0.35	0.36	1.00
Block 5	30	100	0.35	0.36	2.00
Off Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.36
Block 3	10	20	0.35	0.36	0.50
Block 4	20	30	0.35	0.36	1.00
Block 5	30	100	0.35	0.36	2.00
Multiple Family					
Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.36
Block 3	10	20	0.35	0.36	0.50
Block 4	20	30	0.35	0.36	1.00
Block 5	30	100	0.35	0.36	2.00
Off Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.36
Block 3	10	20	0.35	0.36	0.50
Block 4	20	30	0.35	0.36	1.00
Block 5	30	100	0.35	0.36	2.00
Commercial					
Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.36
Block 3	10	20	0.35	0.36	0.50
Block 4	20	30	0.35	0.36	1.00
Block 5	30	100	0.35	0.36	2.00
Off Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.36
Block 3	10	20	0.35	0.36	0.50
Block 4	20	30	0.35	0.36	1.00
Block 5	30	100	0.35	0.36	2.00
Industrial					
Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.36
Block 3	10	20	0.35	0.36	0.50
Block 4	20	30	0.35	0.36	1.00
Block 5	30	100	0.35	0.36	2.00
Off Peak Period					
Block 1	0	0	0.00	0.00	0.00
Block 2	0	10	0.35	0.36	0.36
Block 3	10	20	0.35	0.36	0.50
Block 4	20	30	0.35	0.36	1.00
Block 5	30	100	0.35	0.36	2.00

SJRWMD EXHIBIT 3a

Table 22 OUTPUT Projected Water Use Change by Customer Class, kgal

Customer Class	Water Use Change, percent(a)	Projected Annual Water Use, kgal (b)	Water Use Change, kgal (c)	Net Projected Annual Water Use, kgal (d)
Single Family	-11.59%	2,449,924	(283,968)	2,165,956
Multiple Family	0.00%	171,245	0	171,245
Commercial	-5.86%	312,462	(18,309)	294,153
Industrial	-7.45%	159,952	(11,924)	148,028
Total	-10.16%	3,093,583	(314,200)	2,779,383

(a)From Table 16 in Price Impact Module.
(b)From Table 20.
(c)Water use change percent times projected water use.
(d)Projected water use plus water use change.

Table 23 OUTPUT Revenue Impact by Rate Component and Customer Class

Description	Projected Revenue
Revenue Generated With Proposed Rates (a)	
Service Charge	
Meter Independent	0
Meter Dependent	795,992
Subtotal, Service Charge	795,992
Quantity Charge	
Single Family	1,985,949
Multiple Family	264,546
Commercial	481,058
Industrial	294,796
Subtotal, Quantity Charge	3,026,350
Total Revenue Generated	3,822,342
Revenue Requirements (b)	
Service Charge	
Meter Independent	797,416
Meter Dependent	0
Subtotal, Service Charge	797,416
Quantity Charge	
Existing Revenue Requirement	1,098,222
Change in Revenue Requirement (variable costs)	(11,154)
Subtotal, Quantity Charge	1,087,068
Total Revenue Requirement	1,884,484
Revenue Surplus (Shortfall)	1,937,858

(a) Calculated using Net Projected Water Use from Table 22, proposed weighted water rates from Table 10, and service charges from Table 5 in Price Impact Module. Accounts and equivalent accounts from Table 17 and 19, respectively.

(b) Projected revenue requirements from existing rates from Table 21 adjusted for change in variable costs. The variable cost percent of quantity charge revenue requirements can be adjusted in cell F9.