month. This is equivalent to about 1.8 percent per year reduction in per connection water use for Monarch in Texas.

V. PER CAPITA MUNICIPAL USE IN TEXAS WATER DEVELOPMENT BOARD DEMAND PROJECTIONS FOR REGIONAL PLANNING

Q. ARE YOU FAMILIAR WITH THE PROJECTIONS OF MUNICIPAL WATER DEMANDS IN THE STATE OF TEXAS' REGIONAL WATER PLANNING PROCESS?

A. Yes. I have participated in the development of projections of municipal water demands in all four rounds of regional water planning completed to date, and I have also used projections developed for regional water planning in my own planning efforts for clients.

Q. IN GENERAL TERMS, PLEASE DESCRIBE HOW PROJECTIONS OF MUNICIPAL WATER DEMAND ARE DEVELOPED IN TEXAS REGIONAL WATER PLANNING.

A. Projections are done by Water User Group. For municipal water demands, municipalities with population over 500 and other water suppliers that supply over an annual average of over 0.25 million gallons per day are considered to be separate Water User Groups. Smaller suppliers and individual homes that supply their own water are lumped together by county in "County-Other" water user groups. The projections of municipal water demand for each Water User Group are based on projected population multiplied by projected per capita (per person) municipal use.

Q. IN DEVELOPING THE PROJECTIONS OF PER CAPITA MUNICIPAL DEMAND, HAS THE TWDB MADE ANY COMPUTATIONS OF THE

EXPECTED IMPACT OF THE LOW WATER USE APPLIANCES AND LOW FLOW PLUMBING FIXTURES ON FUTURE WATER USE?

A. Yes, they have. In developing projected municipal water use for the 4th round of regional water planning, the TWDB compared the expected per capita municipal use in a home without water-efficient fixtures/appliances to use in a home with them. TWDB estimated the following reductions in per capita municipal use in gallons per capita per day (gpcd): (1) 16 gpcd due to low water use toilets and low flow showerheads required in the 1991 State Water-Efficient Plumbing Act; (2) an additional 1.63 gpcd due to changing from low water use toilets (1.6 gallons per flush) to high-efficiency toilets (1.28 gallons per flush) as required in recent legislation; (3) an additional 1.61 to 1.90 gpcd due to water-efficient dishwashers; and (4) an additional 6.45 gpcd due to water-efficient clothes washers. Thus, the total difference in per capita municipal use due to water-efficient fixtures/appliances is 25.69 to 25.98 gpcd.

It should be noted that a part of the savings due to water-efficient appliances has already been achieved. Any existing facilities constructed after an element of the requirements for water-efficient fixtures/appliances was implemented would already reflect the savings from that requirement. Similarly, any replacement of appliances or fixtures would incorporate the savings from the measures required at the time of the replacement. To account for this, the TWDB determined the expected future conservation savings for each Water User Group for use in regional planning. The amount of future savings depends on the degree to which current use already reflects conservation savings, which in turn depends on when houses were constructed and

how many fixtures and appliances have been changed in older houses. The TWDB used population growth to determine the percent of newer houses and assumed an appropriate rate of replacement for each type of fixture or appliance.

Q. DID THE TWDB DETERMINE THE EXPECTED REDUCTION IN PER CAPITA USE FOR MONARCH OR ANY OF ITS SYSTEMS?

A. Not directly. Each of Monarch's systems is too small to be included as a separate Water User Group in regional water planning. As a result, Monarch's systems are considered as a part of the County-Other Water User Group in the counties in which they are located. Monarch has systems located in Bandera, Brazoria, Chambers, Denton, Grayson, Hays, Henderson, Hood, Johnson, Liberty, Marion, Matagorda, Medina, Montgomery, Parker, Polk, San Jacinto, Smith, Tarrant, Trinity, Tyler, Van Zandt, Wise and Wood counties.

Q. PLEASE IDENTIFY TABLE 1.

A. Table 1 is a table that I developed showing TWDB's projected reductions in County-Other municipal per capita water demands due to water-efficient fixtures/appliances.

Q. DID YOU PREPARE THIS TABLE?

A. Yes, I did.

Q. DOES TABLE 1 ACCURATELY REFLECT TEXAS WATER DEVELOPMENT BOARD DATA ON PROJECTED REDUCTIONS PER CAPITA MUNICIPAL WATER USE FOR THESE COUNTY-OTHER WATER USER GROUPS?

A. Yes, it does.

Q. ARE THE TEXAS WATER DEVELOPMENT BOARD DATA SHOWN IN TABLE 1 A RELIABLE SOURCE OF INFORMATION ON REDUCTIONS IN PER CAPITA MUNICIPAL WATER DEMAND DUE TO WATER-EFFICIENT FIXTURES/APPLIANCES?

A. Yes. The TWDB has conducted a careful analysis of the impact of these projections, and the results are reasonable.

Q. ARE THESE DATA REGULARLY USED IN WATER SUPPLY PLANNING BY PROFESSIONALS LIKE YOURSELF?

A. Yes. These data are a part of the development of projected per capita municipal water demands for regional water planning. The resulting demands are used for regional water planning and are often used in other water planning efforts.

Table 1

Reduction in Per Capita Municipal Demand for County-Other Water User Groups in Counties Served by Monarch

County	Base per Capita Use (GPCD)	Projected Reduction in Per Capita Municipal Demand Due to Water-Efficient Fixtures/Appliances						% Reduction, Base to 2020
		2020	2030	2040	2050	2060	2070	
Bandera	102	9.07	12.21	13.99	14.90	15.12	15.15	8.9%
Brazoria	146	10.19	14.05	16.04	16.93	17.15	17.23	7.0%
Chambers	109	7.50	10.31	11.84	12.61	12.86	12.95	6.9%
Denton	118	6.15	7.65	8.34	9.09	9.55	9.77	5.2%
Grayson	123	9.60	13.90	17.55	18.30	19.03	19.43	7.8%
Hays	118	8.18	11.05	13.10	13.79	14.07	14.16	6.9%
Henderson	91	9.19	14.10	18.03	18.39	18.79	18.80	10.1%
Hood	102	8.67	13.61	13.93	14.34	14.76	14.90	8.5%
Johnson	103	7.89	10.88	13.06	13.90	14.25	14.27	7.7%
Liberty	118	9.34	13.51	16.82	18.58	18.90	18.94	7.9%
Marion	67	7.00	7.00	7.00	7.00	7.00	7.00	10.4%
Matagorda	103	9.84	14.14	17.37	19.07	19.36	19.39	9.6%
Medina	124	8.39	11.53	13.68	14.82	15.12	15.16	6.8%
Montgomery	118	8.98	11.75	12.87	13.35	13.51	13.58	7.6%
Parker	124	8.07	10.98	13.23	14.98	15.53	15.75	6.5%
Polk	102	9.19	12.80	15.20	16.42	16.70	16.74	9.0%
San Jacinto	110	7.96	10.70	12.38	13.30	13.58	13.64	7.2%
Smith	114	8.86	12.36	14.49	15.52	15.80	15.89	7.8%
Tarrant	207	8.48	12.09	15.05	17.23	17.10	18.35	4.1%
Trinity	74	10.06	14.00	14.00	14.00	14.00	14.00	13.6%
Tyler	122	9.16	13.18	16.50	18.32	18.63	18.64	7.5%
Van Zandt	101	8.73	12.11	14.36	15.55	15.84	15.89	8.6%
Wise	115	7.82	10.82	13.16	15.05	15.49	15.61	6.8%
Wood	94	8.00	9.05	9.38	9.70	10.00	10.02	8.5%
Average	**113**	**8.60**	**11.82**	**13.81**	**14.80**	**15.09**	**15.22**	**8.0%**

Q. WHAT DOES TABLE 1 SHOW?

A. For each Texas county in which Monarch has a water supply system, the second column from the left in the table shows the base dry year municipal per capita demand for water. This represents the expected per capita municipal demand for

County-Other users in that county in a dry year. (As discussed above, the County-Other Water User Group for each county represents the combined municipal water use of small water suppliers and individual consumers.) The base dry year municipal per capita demand represents the per capita municipal demand that would be expected under dry conditions in the base year, which is generally 2011. (Per capita municipal demand is typically higher in a dry year than in other years because of increased outdoor water use.) The next six columns represent the expected reduction in per capita municipal water demand because of water-efficient fixtures/appliances for those County-Other Water User Groups. The right-hand column indicates the percent reduction to the base per capita municipal water demand projected for 2020 by the TWDB. The bottom row shows the averages of the numbers for the various counties. The average reduction in per capita municipal water demand for the 24 County-Other Water User Groups listed in Table 1 due to water-efficient fixtures/appliances is 8 percent from the base year (2011) to 2020 – slightly less than one percent per year. Note that this is the reduction due only to water-efficient fixtures/appliances. Other factors could also affect per capita municipal water demand.

Q. WHAT DOES THE INFORMATION IN TABLE 1 TELL US ABOUT PER CAPITA MUNICIPAL WATER DEMAND FOR MONARCH?

A. Monarch systems are a part of each of the County-Other Water User Groups listed in Table 1. The table shows that there is expected to be a trend of decreasing per capita municipal water demand due to water-efficient fixtures/appliances and that the trend is expected to continue to and beyond 2020. Independent of other factors, water-

efficient fixtures/appliances should cause a reduction in per capita municipal water demand of slightly less than 1 percent per year through 2020.

VI. IMPACT OF DROUGHT RESTRICTIONS

Q. HOW DO DROUGHT RESTRICTIONS TEND TO INFLUENCE THE PER CAPITA MUNICIPAL WATER DEMAND?

A. As discussed above, drought restrictions are measures designed to temporarily reduce water use during times of drought or other emergency, when demand is threatening to exceed supply.

Q. PLEASE IDENTIFY TABLE 2.

A. Table 2 is a table that I developed showing when Monarch water systems in Texas were under drought restrictions between 2011 and 2015.

Q. DID YOU PREPARE THIS TABLE?

A. Yes, I did.

Q. WHAT IS THE SOURCE OF THE INFORMATION SHOWN IN TABLE 2?

A. Table 2 is based on information provided by Monarch.

Q. DO YOU USE THE KIND OF INFORMATION PROVIDED IN TABLE 2 IN YOUR PROFESSIONAL WORK?

A. Yes. I commonly rely on information provided by water suppliers on the operation of their systems.

Q. **WHAT DOES TABLE 2 SHOW?**

A. It shows which of the Monarch systems in Texas were in drought restrictions from 2011 through 2015 and in which months they were in drought restrictions. In every

year from 2011 through 2015, between 8 and 12 Monarch systems in Texas were under drought restrictions during all or part of the year.

Table 2
Drought Restrictions for Monarch Systems in Recent Years

District Name	Connection Count	Drought Restrictions in Recent Years				
		2011	2012	2013	2014	2015 (through September)
Acton (Royal Oaks)	71	Jun-Dec	Jan-Dec	Jan-Feb		
Aurora Vista	134					
Beachwood Estates	450			Jun-Dec	Jan-Dec	Jan-Sep
Benbrook Hills	12					
Blue Mound	799					
Blue Water Cove	31					
Briarwood Harbor	30					
Callender Lake	638					
Camelot Forest	79					
Carolynn Estates	1,070			June-Dec	Jan-Dec	Jan-Sep
Cedar Valley	59					
Cherokee Shores	651			June-Dec	Jan-Dec	Jan-Sep
Chesswood	33					
Coldspring Terrace	114					
Comanche Cove	414					Aug-Sep
Comanche Harbor/Ports O Call	438	Jun-Dec	Jan-Dec	Jan-Feb		Aug-Sep
Countrywood	37					
Crowley	536					
Crystal Springs	84					
Decker Hills	1,169					
Denton Creek Estates	117					
Falcon Crest Addition	63					
Garden Acres	35					
Governors Point	154					
Granbury Acres	82					

Table 2
Drought Restrictions for Monarch Systems in Recent Years

District Name	Connection Count	Drought Restrictions in Recent Years				
		2011	2012	2013	2014	2015 (through September)
Green Acres	67					
Harbor Point	275					
Hideaway Bay Estates	75					
Highsaw Water	540					
Holiday Shores	137					
Holiday Villages of Fork	279					
Holiday Villages of Livingston	561					
Hulon Lakes	249					
Indian Hills Harbor	96					
Ivanhoe	678					
Lake Medina Shores	665	Apr-Dec	Jan-Dec	Jan-Dec	Jan-Dec	Jan-Apr
Lakeway Harbor	283					
Lollilop Landing	74					
Longhorn Valley	35					
Markum Ranch Estates	53					
Metroplex Homesteads	1,069					
Midway Utilities	422					
Montego Bay Estates	123	Jul-Dec	Jan-Dec	Jan-Feb		
Nolan River Estates	95					
Oak Trail Shores	1,402				Jun-Dec	Jan-Apr
Oakwood	55					
Phillips Acres	21					
Pine Harbor	285					
Pine Trail Shores	269					
Pinwah Pines	58					

Table 2
Drought Restrictions for Monarch Systems in Recent Years

District Name	Connection Count	Drought Restrictions in Recent Years				
		2011	2012	2013	2014	2015 (through September)
Plum Creek	2,230	Apr-Dec	Jan-Dec	Jan-Feb	Jun, Aug-Dec	Jan
Ponderosa Addition	45					
Rancho Brazos	122	Jun-Dec	Jan-Dec	Jan-Feb		
Raywood	83					
Ridgecrest Estates - Johnson	142	Jun-Dec	Jan-Oct			
Ridgecrest Grayson County	498					
River Oaks Ranch	108	May-Dec	Jan-Dec	May-Dec	Jan-Dec	Jan-Sep
Rocky Point Estates "A"/"B"	111					
Serenity Woods Pineloch	135					
Shepherd Hill Estates	19					
Sherwood Shores	577					
Silver Saddle	20	June-Dec	Jan-Dec	Jan-Feb		Aug-Sep
Southern Acres	10					
Spanish Park Estates	32					
Stonecrest Estates	128					
Sundance	256					
Tanglewood	1,192					
Tex-Rides Fifth	17					
Tower Terrace	243					
Triple H Estates	23					
Twin Creeks Addition	245			Sep-Dec	Jan-Dec	Jan-Sep
Western Hills Harbor	406					
Western Lake Estates	547					

Table 2
Drought Restrictions for Monarch Systems in Recent Years

District Name	Connection Count	Drought Restrictions in Recent Years				
		2011	2012	2013	2014	2015 (through September)
West Meadows	28					
West Park Village	26					
Westside	262					
Westview - Parker County	47					
Westwood Beach	599					
Wynnwood Haven	151					

Notes: Connection count is as of April 2015 except that Lake Medina Shores, Ridgecrest Estates, and River Oaks Ranch are as of December 2014.

Q. BASED ON YOUR EXPERIENCE, WHAT IS THE EXPECTED IMPACT OF DROUGHT RESTRICTIONS ON DEMAND?

A. That depends very much on the sort of drought restrictions imposed. Mandatory drought restrictions, limiting the allowable hours or allowable days for outdoor water use, generally reduce water use, sometimes significantly. Voluntary drought restrictions sometimes have limited impact on water use.

Q. WHAT IS THE IMPACT OF DROUGHT RESTRICTIONS ON WATER USE AFTER THE DROUGHT ENDS AND THE WATER RESTRICTIONS ARE DISCONTINUED?

A. Based on my experience, there can be a residual effect of reduced water use for a time, but water use tends to return to normal within a few months or years.

Q. IS IT LIKELY THAT SOME MONARCH SYSTEMS WILL BE UNDER DROUGHT RESTRICTIONS IN THE FUTURE?

A. It seems likely that some systems will be in restrictions. As of September 2015, the last month for which data were available to me, eight Monarch systems in Texas were under drought restrictions.

Q. IS IT POSSIBLE TO PREDICT WHICH SYSTEMS WILL BE UNDER DROUGHT RESTRICTIONS AND WHEN THEY WILL BE UNDER RESTRICTIONS?

A. With current weather forecasting capabilities, it is impossible to predict future weather accurately enough to determine which systems will be under drought restrictions in the future and when they will be under restrictions.

VII. CONCLUSION

Q. BASED ON YOUR ANALYSIS, WHAT CONCLUSIONS DO YOU DRAW REGARDING WATER USE BY MONARCH SYSTEMS IN TEXAS AND WHY?

A. I believe that the per capita and per connection water use for Monarch are likely to continue to decline in for the next few years. Over the last few years, municipal per capita water use in Texas has been declining, as has the per connection water use for Monarch systems in Texas. Texas Water Development Board projections of municipal per capita water use in the future indicate that water-efficient fixtures/appliances required by current laws and regulations will further reduce municipal per capita water use in the state.

Q. BASED ON YOUR EXPERIENCE, WHAT DO YOU THINK HAS CAUSED THE DECLINE IN MUNICIPAL PER CAPITA AND PER CONNECTION WATER USE?

A. I believe that the requirements for water-efficient fixtures/appliances, which began with the 1991 State Water-Efficient Plumbing Act and have been strengthened by subsequent laws and regulations, have had a major role in reducing per capita and per connection municipal water use in recent years. In addition, I think there is an increased level of awareness of the importance of water conservation in Texas, particularly in areas where major utilities have conducted public education and information campaigns promoting conservation. Those campaigns reach other consumers as well as the customers of the sponsoring utilities and influence behavior over a large area.

Q. DO YOU HAVE AN OPINION ON THE LIKELY RATE OF CHANGE IN PER CONNECTION AND PER CAPITA DEMAND IN THE FUTURE?

A. For the near next few years, I feel that demand is likely to change at a rate similar to that of the recent past. Over time, I would expect the rate of change in per capita and per connection demand to slow, as most houses will have water-efficient fixtures/appliances and most people are reached with public information campaigns.

Q. HAVE YOU REVIEWED THE TESTIMONY OF JOHN HUTTS IN THIS CASE?

A. Yes, I have.

Q. ARE HIS ANALYSIS AND CONCLUSIONS REGARDING THE IMPACT OF WEATHER ON WATER USE CONSISTENT WITH YOUR EXPERIENCE?

A. Yes. Mr. Hutts found that higher temperature and lower rainfall correlate with higher water use and that temperature and rainfall have the greatest impact on summer water use. All of these findings are consistent with my experience.

Q. IN YOUR OPINION, IS IT APPROPRIATE TO ADJUST HISTORICAL WATER USE TO ACCOUNT FOR THE IMPACT OF DEVIATIONS FROM NORMAL WEATHER PATTERNS, AS MR. HUTTS HAS DONE?

A. Yes, it is.

Q. IN YOUR OPINION, HAS MR. HUTTS USED AN APPROPRIATE METHODOLOGY TO MAKE THIS ADJUSTMENT?

A. Yes, he has.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes, it does.

FREESE NICHOLS

Thomas C. Gooch, P.E.

Vice President
Water Resource Planning Group Manager

Years Experience:
With This Firm: 34 With Other Firms: 3

Education:
M.S., Civil Engineering (Water Resources), Stanford University, 1978
B.S., Civil Engineering (Water Resources), Massachusetts Institute of Technology, 1977
B.S., Humanities and Science (Literature), Massachusetts Institute of Technology, 1977

Registration:
Professional Engineer, Texas #50668, 1982
Professional Engineer, Arkansas #7445, 1990
Professional Engineer, Louisiana #23560, 1989
Professional Engineer, Missouri #E-24632, 1990
Professional Engineer, Oklahoma #15798, 1989

Professional Experience:
1980 - Present:
Freese and Nichols, Inc., Fort Worth, Texas, Hydrologist and Engineer

1988 - Present: Principal
1986 - 1988: Associate

1978 - 1980:
Camp, Dresser and McKee, Inc., Waltham, Massachusetts, Water Resource Engineer, Hydrologic and hydraulic analysis of flooding; floodplain management; dam safety investigations

1977 (Summer):
Turner, Collie and Braden, Inc., Houston, Texas, Senior Engineering Aide, Preliminary design of an urban stormwater drainage system

1975 - 1976:
Freese and Nichols, Inc., Inspector, construction inspection for pipelines, roads, railroads and dams

1974 (Summer): Freese and Nichols, Inc., Junior Engineering Aide, Red River 208 Water Quality Management Plan

EXPERIENCE
37 years

EDUCATION
M.S., Civil Engineering - Water Resources, Stanford University

B.S., Civil Engineering, Massachusetts Institute of Technology

B.S., Humanities and Science, Massachusetts Institute of Technology

REGISTRATION
Professional Engineer
Texas #50668
Arkansas #7445
Louisiana #23560
Missouri #24632
Oklahoma #15798

A vice president of the firm and leader of the water resource planning discipline, Mr. Gooch is a hydrologist and serves as project manager for water supply planning, analyses of water rights, reservoir operation studies, water quality evaluations, analyses of flooding, preliminary design and cost estimates for water supply projects and transmission systems, economic analyses, and water and sewer rate studies.

Representative Projects Experience:

Water Resource Planning

- **Senate Bill One, Regional Water Planning for Region C** - Lead consultant for regional water planning covering the Dallas/Fort Worth Metroplex and surrounding counties. Development of population and water use projections, analysis of existing supplies, and development of long-range water supply plans. Plans are updated every 5 years – completed 3 plans and working on the fourth.
- **North Texas Municipal Water District, Water Supply Planning** - Analysis of potential reservoirs for additional water supply including yield analyses, impact of existing water rights, impact of proposed Texas environmental flow criteria, environmental impacts of projects, and cost estimates for reservoirs and transmission systems.
- **Sabine River Authority of Texas, Watershed Management Plan** - Development of a comprehensive watershed management plan for the Sabine Basin including development of demand projections, comparison of existing supplies to projected demands, surveys and meetings with major water suppliers and wastewater treatment providers, analysis of potential new water supply projects, and analysis of water quality and environmental issues.
- **City of Fort Smith, Arkansas, Water Supply Plans** - Review of competing long-range water supply plans including comparative analysis of potential reservoirs, review of cost estimates, and review of hydrologic analyses.
- **North Texas Municipal Water District, Raw Water Supply System** - System operation study including Lake Lavon, Lake Texoma, and Cooper Lake. Development of operating policies and analysis of impacts on power cost, reservoir elevation, and water quality.
- **Lower Rio Grande Valley, Water Supply Planning** - Long-range water supply including review and correction of previously developed hydrology, analysis of potential water supply projects, water conservation and drought contingency planning and analysis of environmental impacts.
- **City of Cleburne, Texas, Water Supply Planning** - Development of a long-range water supply plan including projection of water needs, comparison of existing supply and projected needs, analysis of alternatives for additional supply, preliminary design of new facilities, cost estimates, and life cycle cost estimates.
- **Saltillo, Coahuila, Mexico, Water Supply Planning** - Development of a long range water supply plan including projections of population and water use, determination of yield from existing

groundwater sources, plans for new water supply development from additional groundwater, importation of surface water, and wastewater reuse.

- **Sabine River Authority, Water Supply Planning** - Water supply planning for southeast Texas (including the Houston area) as part of the Trans-Texas Water Program.
- **Tarrant County Water Control and Improvement District No. 1, Raw Water Supply System (7 reservoirs, 9 pump stations, 16 delivery points)** - Development of a computer operation model to allow operators to study the impact of operation policies on yields, shortages, pumping costs, and reservoir elevations.
- **City of Plainview, Texas and Vicinity, Water Supply Planning** - Regional water supply planning including projections of water use, development of a conservation plan, review of water treatment plant, study of wastewater reuse, analysis of groundwater supplies and facilities, analysis of water supply alternatives, economic analysis, and development of recommended long range water supply plan.
- **Texas National Research Laboratory Commission, Water Supply Planning** - Regional water supply plan for the Superconducting Super Collider and surrounding area in western Ellis County including projections of water use, development of alternative plans, preliminary design and economic analyses.
- **Sabine River Authority, Feasibility Planning** - Feasibility planning, preliminary design, and economic analyses on a proposed regional water supply system around Lake Tawakoni.
- **Tarrant County Water Control and Improvement District No. 1** - Analysis of long-range water supply.
- **Sabine River Authority of Texas, Water Supply Planning** - Regional water supply planning and analysis of reservoir system operation in the Upper Sabine Basin.
- **City of Grand Prairie, Texas, Water Supply Planning** - Analysis of long-range water supply.
- **West Central Texas Municipal Water District, System Operation Model** - Development of a system operation model (yield and pumping cost), investigation of alternative operation policies, and development of a recommended policy.
- **E.V. Spence Reservoir, TMDL Study** - Quality assurance for Total Maximum Daily Load (TMDL) study. Modeling of reservoir quality, impact of upstream diversion and impact of water quality management practice.

Water Availability Modeling and Water Rights Analysis

- **North Texas Municipal Water District** – Development of an accounting plan meeting TCEQ requirements for Lake Lavon to track imported water, reuse of treated wastewater, daily diversions by source, storage emptied by junior diversions and other issues.
- **City of El Paso, Texas, Water Rights Analysis** – Hydrologic analyses to support El Paso in adjudication of water rights in the upper Rio Grande Basin.

- **Texas Commission on Environmental Quality, Water Availability Modeling** - Principal-in-charge of water availability modeling of the Brazos Basin and the Brazos-Colorado Coastal Basin. Responsible for work plan development, development of naturalized flows, development of model for part of the basin and quality control of modeling efforts.
- **Texas Commission on Environmental Quality, Water Availability Modeling** - Principal-in-charge of water availability modeling of the Trinity and San Jacinto Basins and two coastal basins. Responsible for work plan, development of naturalized flows and quality control of modeling efforts.
- **Texas Commission on Environmental Quality, Water Availability Modeling** - Water availability modeling of the Neches River Basin. Specific responsibilities included development of a detailed work plan, development of naturalized flows, and QC of modeling efforts.
- **Trinity River Authority, City of Houston, and Tarrant Regional Water District, Water Availability Modeling** - Water availability modeling for the Trinity Basin. The purpose of the study was to use existing hydrologic data to determine the impact of a proposed reuse project on downstream water availability using the WRAP computer model.
- **Brazos River Authority, Water Availability Modeling** - Water availability modeling of Proctor Reservoir and water rights in its watershed using the WRAP model.
- **City Public Service of San Antonio, Water Rights Analysis** - Water rights and reservoir yield analysis of surface water supply sources in the Brazos River Basin.
- **North Texas Municipal Water District, Water Rights Analysis** - Analysis of water rights, yield and water quality for diversions from Lake Texoma to Lake Lavon.
- **Brazos River Authority, Water Rights Analysis** - Analysis of water rights, yield, reservoir system operations and flood control operation of a proposed reservoir.

Permit Applications

- **North Texas Municipal Water District, Water Right Permit** - Development of planning and hydrologic analysis to support an application for a water right for the proposed Lower Bois d'Arc Creek Reservoir.
- **Brazos River Authority, Water Right Permit** - Development of hydrologic and environmental analyses, preparation of a report, testimony and assistance in negotiations with protestants in support of a system operation permit.
- **Upper Trinity Regional Water District, Water Right Permit** – Testimony in water right hearing for the proposed Lake Ralph Hall on Upper Trinity Regional Water District water conservation efforts and the consistency of the Ralph Hall project with the regional water plan.
- **North Texas Municipal Water District, Water Right Permit** - Development of planning and hydrologic analysis to support an application for a water right allowing reuse of treated wastewater from the East Fork of the Trinity River.
- **Daisy Farms, Water Right Permit** – preparation of application and supporting materials to develop a water supply for irrigation from two reservoirs to be filled by runoff and diversions

from a nearby creek. The application also seeks authorization for impoundment in six existing and two proposed reservoirs.

- **City of Weatherford** – Hydrologic and water right analysis of reuse of treated wastewater in Lake Weatherford, including preparation of an application for a Texas water right and coordination with potential stakeholders.
- **North Texas Municipal Water District, Water Right Permit** – Development of hydrologic analysis to support an application for additional diversions from Lake Lavon.
- **Greater Texoma Utility Authority, Water Right Permit** - Development of hydrologic and environmental analysis to support an application for an inter-basin transfer from the Red River Basin to the Trinity Basin.
- **Brazos River Authority and the City of Houston, Texas, Water Right Permit** - Development of hydrologic analysis and preparation of report to support the application by the Brazos River Authority and the City of Houston for a major amendment to the permit for Allens Creek Reservoir.
- **North Texas Municipal Water District, Water Right Permit** - Development of hydrologic and environmental analysis and preparation of report supporting an application for water rights in Lake Texoma and an inter-basin transfer from the Red River Basin to the Trinity Basin.
- **Somervell County Water District, Water Right Permit** - Development of hydrologic analysis and preparation of report supporting water rights and 404 permitting for a proposed water supply system including a channel dam, pump station, raw water pump station, and off channel reservoir to develop a water supply from the Paluxy River.
- **City of San Marcos, Texas, Expert Testimony for Permit Application** - Expert testimony for application by the City of San Marcos for bed and banks permit for reuse of treated wastewater effluent.
- **City of Stamford, Texas, Water Right Permit** - Development of hydrologic and engineering data to support application by the City of Stamford for a channel dam and diversion from Paint Creek into Lake Stamford.
- **City of Cleburne, Texas, Water Right Permit** - Development of hydrologic and engineering data to support an application by the City of Cleburne for overdrafting of Lake Pat Cleburne, backed up by delivery of water from Lake Aquilla.
- **Sabine River Authority, 404 Permitting** - Water rights and Section 404 permitting for a raw water pump station and channel weir on the Sabine River.
- **City of Stephenville, Texas, Water Rights Analysis** - Analysis of water rights and reservoir yield for Paluxy Reservoir.
- **Tarrant County Water Control and Improvement District No. 1, Impact Analysis** - Analysis ot the impact of a proposed upstream reservoir on an existing project.

- **North Texas Municipal Water District, Diversion Permitting** - Assistance with permitting for diversions from Lake Texoma to Lake Lavon.
- **Brazos River Authority, Impact Analysis** - Analysis of the impact of proposed FERC release requirements on yield and reservoir elevations in Possum Kingdom Reservoir.

Drainage and Flood Studies

- **Brazos River Authority, PMFD Study** - Probable maximum flood development for existing and proposed reservoirs in the Brazos River Basin.
- **Brazos River Authority and Others, Dam Breach Analyses** - Dam breach analyses involving the determination of flooding resulting from potential dam failures.
- **Brazos River Authority, Flood Control Analysis** - Analysis of flood control operation of the proposed South Bend Reservoir.
- **City of Grapevine, Texas, Master Drainage Plan** - Master Drainage Plan development.

Reservoir System Operation Studies

- **North Texas Municipal Water District (5 reservoirs)**
- **Tarrant Regional Water District System (7 reservoirs)**
- **Colorado River Municipal Water District (3 reservoirs)**
- **Lower Neches Valley Authority (2 reservoirs and channel dam)**
- **Sabine River Authority (3 reservoirs)**
- **City of Houston (3 reservoirs and channel dam)**
- **Brazos River Authority (12 reservoirs)**
- **West Central Texas Municipal Water District (2 reservoirs)**
- **Daisy Farms (two reservoirs and channel diversion)**

Water and Sewer Rate Studies and Economic Analyses

- **Cities of Bryan, Lufkin, Mansfield, Beaumont, Kennedale, Burleson, Breckenridge, Brownwood, Cleburne, Eastland, and Grapevine, Texas** - Water and sewer rate studies.
- **Northeast Texas Municipal Water District, Cities of Austin, Brownwood, Sachse, and Snyder, Texas** - Cost of service analyses.
- **Cities of Hurst and Grapevine, Texas** - Impact fee studies (twice for Hurst; three times for Grapevine).

Water Conservation and Drought Contingency Plans and Drought Response

- **Cities of Cleburne, Garland, Lancaster, and Pearland, Brazos River Authority, Lower Neches Valley Authority, North Texas Municipal Water District, Sabine River Authority, and Somervell County Water District.** Development of Water Conservation and Drought Contingency plans.
- **North Texas Municipal Water District, Assistance with Comprehensive Drought Response.** In response to on-going drought, assisted with the implementation of drought response measures and tracking of results, developed models of water supply system operation in a continuing drought, assisted with coordination with member cities and customers, assisted with planning and permitting the accelerated development of new supplies.
- **North Texas Municipal Water District.** Development of model water conservation and drought contingency plans for use by customers.

Professional Societies

Texas Water Conservation Association, Board of Directors
American Society of Civil Engineers
American Water Works Association
American Water Resources Association
Red River Valley Association, Board of Directors

Honors and Awards

MIT Alumni Association, Kane Award, Exceptional Service in Fund-Raising
MIT Alumni Association, Morgan Award, Exceptional Service as an Educational Counselor
Chi Epsilon
Tau Beta Pi
Phi Beta Kappa
Nomination for "Outstanding Young Leader of Tarrant County," 1987
Marvin C. Nichols Award for best paper by Freese and Nichols employee, 1989, 1991 and 1999
Longhorn Council, Boy Scouts of America, Engineering Scout of the Year, 2006.

Books, Papers and Presentations:

Red River Valley Association Regional Water Resource Conference, "Texas Water Rights," Texarkana, May 30, 2013.

Texas Municipal Utilities Association Annual Conference, "Water Conservation - Rules, Tools and Innovative Approaches," College Station, May 23, 2013.

North Texas Commission 2013 North Texas Water Summit, "North Texas Water Supply, Past, Present and Future," Irving, March 1, 2013.

Water: An indispensable Resource Seminar, "Case Study: the 2011 Drought in Texas and response to Drought," Springfield, Missouri, November 9, 2012.

North Central Texas Section American Water Works Association Drinking Water Seminar, "Water Conservation Efforts, Fort Worth, October 19, 2012.

With Dan Sefko and Wayne Owen, American Planning Association Texas Section Conference, "Water Planning in Texas – What Planners Need to Know", Fort Worth, October 5, 2012.

"Overview of Texas Surface Water Law – A Hydrologist's Perspective," FN University Surface Water Seminar for San Antonio Water System, San Antonio, May 23, 2012.

"Surface Water Accounting Plans and Regulatory Requirements," FN University Surface Water Seminar for San Antonio Water System, San Antonio, May 23, 2012.

"Status of Regional Water Supply," presented to Plano Learn 2 Live Green Event, Plano, April 14, 2012.

"Sustainability and North Texas Water Supplies," presented to Leadership North Texas, Cedar Hill, March 30, 2012.

"Water Supplies for North Texas," presented to UTA School of Engineering seminar on Envisioning the Future for North Texas and its Metroplex, Arlington, March 20, 2012.

"Texas Drought and Impacts to Raw Water Supplies," presented to UTA Water Systems Design Class, Arlington, March 1, 2012.

"Drought Strategies," presented to Freese and Nichols University, Fort Worth, February 28, 2012; Houston, March 12, 2012; Austin, March 15, 2012; Richardson, July 26, 2012.

"Texas Drought and Impacts to Raw Water Supplies," presented to Texas Municipal Utilities Association, Fredericksburg, January 26, 2012.

"Drought and Raw Water Supplies," presented to FN University Drought Seminar, Fort Worth, November 3, 2011; Lubbock, December 1, 2011; Austin, December 9, 2011; Schertz, January 27, 2012.

"History of Texas Reservoir Development," presented to World Lake Conference, Austin, November 2, 2011.

"North Texas Water Supply Planning," presented to Red River Valley Association, Oklahoma Water Conference, Durant, August 25, 2011.

Water Planning Brown Bag for Greater Dallas Planning Council, Dallas, July 8, 2011.

"Texas Water Rights," presented to Texas Public Works Association, McAllen, June 17, 2011.

"Growing the Bucket through Developed Waters," co-authored with Martin Rochelle and Corey Shockley, presented to Texas Water Conservation Association, Galveston, June 16, 2011.

"The Impact of Indirect Reuse in Water Supply Planning," presented to Texas Association of Water Quality Agencies, Seagoville, May 27, 2011.

"Sustainability and North Texas Water Supplies," presented to Leadership North Texas, Dallas, April 29, 2011.

"Regional Water Planning and Infrastructure in Texas," presented to U.S. Chamber of Commerce/AGC Invest in Water Seminar, Austin, March 16, 2011.

"Texas Water Plan and Region C Water Plan," presented to UTA Water Systems Design Class, Arlington, March 10, 2011.

"Region C Water Plan," presented to U.S. Department of Agriculture Emerging Communities Dallas-Fort Worth Regional Workshop, Richardson, November 11, 2010.

"Building from Regional to Statewide Planning: The Texas Approach to Water Planning," co-authored with Carolyn Brittin and Mike Reedy, presented to U.S. Society on Dams and paper, Sacramento, April 14, 2010.

"Region C Water Plan," presented to University of Texas at Arlington Student Chapter, American Society of Civil Engineers, Arlington, April 7, 2010.

"System Operation of Existing Reservoirs and Water Rights – How it Works in the Brazos Basin – Technical Issues and Environmental Protection," presented to University of Texas Water Law Seminar, Austin, December 10, 2009.

"Texas Water Plan and Region C Water Plan," presented to University of Texas at Arlington Water Systems Design Class, Arlington, March 26, 2009.

"Texas Water Plan as it Affects North Texas and Water for Energy in North Texas, presented to Geological Society of America Meeting, March 16, 2009.

Presentation on Texas Water Plan and Region C Water Plan to American Planning Association National Infrastructure Investment Task Force Hearing, Arlington, March 9, 2009.

"Water Accounting Plans and their Use in Water Rights," co-authored with Kathy Alexander and Lyn Clancy, presented at the Texas Water Conservation Association Annual Meeting, Austin, February 2009.

"Reviewing the Texas Water Plan," presented to HalfMoon Seminar on *Texas Water Law*, Arlington, February 18, 2009.

"Region C Update," presented to Houston-Galveston Area Council Natural Resources Advisory Committee, Houston, January 5, 2009.

Texas Water Development Board Report 370, Reservoir Site Protection Study. Co-Author with Gilbert E. Kretzschmar, P.E., Samuel K. Vaugh, P.E., Robert B. Perkins, P.E., Robert J. Brandes, Ph.D., P.E., Richard D. Purkeypile, P.E., Simone F. Kiel, P.E., and Barney N. Austin, Ph.D., P.E., Austin, Texas, July 2008.

"Region C Regional Water Issues," presented to University of Texas at Arlington Water Resources Class, Arlington, April 8, 2008.

"Regional Water Planning," presented at Bryan-College Station Regulatory Updates/Trends and Technologies Workshop, Bryan, August 2007.

"North Texas Water Supply", presented at Fort Worth Chapter Texas Society of Professional Engineers Meeting, Fort Worth, July 2007.

"Interbasin Transfers of Water Rights" presented at Lorman Continuing Education Seminar on Water Rights Sales and Transfers in Texas, Fort Worth, March 2007.

"Planning for Texas Future Water Needs," presented at the National Water Resources Association Meeting, San Diego, November 2006

"Reuse and Regional Water Planning," presented at the North Texas Section of the Association of Water Board Directors, Fort Worth, November 2006.

"Current and Future Wastewater Reuse in Texas," with Alan Plummer, presented at the WEFTEC Annual Meeting, Dallas, October 2006.

"Technical Issues in Surface Water Rights Permitting," presented at the FN University Water Rights Seminar for NTMWD and Member Cities, Wiley, Texas, September 2006.

"Interbasin Transfers of Water Rights," presented at the FN University Water Rights Seminar for NTMWD and Member Cities, Wiley, Texas, September 2006.

"Water Availability Modeling and Regional Water Planning," Tom Gooch, presented at the City of Houston PDH Seminar on Water Availability Modeling, Houston, June 2006.

"Regional Water Supply Planning for the Dallas/Fort Worth Area," with Stephanie Griffin, presented at the United States Society on Dams, May 2006.

"Reuse – An Effective and Efficient Use of Texas' Water," with Alan Plummer, presented at the Texas Water Conservation Association, San Antonio, March 2006.

"Regional Water Issues," presented at the North Texas Air and Waste Management Association, Dallas, March 2006.

"Interbasin Transfers of Water Rights" presented at Lorman Continuing Education Seminar on Water Rights Sales and Transfers in Texas, Fort Worth, March 2006.

"Effective Drought Strategies," with Simone Kiel, presented at the American Planning Association Fort Worth Chapter, Fort Worth, March 2006.

"Drought and Raw Water Supplies," presented at the FN University Drought Seminars, Fort Worth and Austin, February and August 2006.

"Potential Conflicts of Interest in the Regional Water Planning Process," presented at Texas Water Law Institute, Austin, Texas, September 2005.

"Technical and Scientific Issues in Water Supply Planning," presented at CLE Texas Water Law Conference, Austin, Texas, September 2005.

"Meeting Future Water Needs, Options and Issues, Inter-Basin Transfers," presented at the Sierra Club Water Conference, Dallas, Texas, October 2003.

"Region C Water Planning: An Update," presented at the North Central Texas American Water Works Association Drinking Water Seminar, October 2003.

"Regional Water Planning: A Consultant's Perspective," presented at the Texas Water Law Institute, Austin, September 2003.

"Water Supply for Tarrant County," presented to the Fort Worth Chamber of Commerce, Economic Development Committee, November 2001.

"Traditional Approaches to Water Supply," presented at Water for People and the Environment conference, Dallas, Texas, November 2001.

"Region C Water Planning Group and Texas Water Initiatives," presented at American Society of Military Engineers Conference, Dallas, Texas, September 2001.

"Water for Texas for the Next Fifty Years," Presented to the Dallas Chamber of Commerce Board, with William B. Madden, September 2001.

"Surface Water Rights Permitting Issues for Water Rights and Water Planning," presented at the CLE Texas Water Law Conference, June 2001.

"Water Supply for North Texas: Marvin Nichols Reservoir," presented to the Dallas Chapter, American Society of Civil Engineers, with Wayne Owen, April 2001.

"Future of Tarrant County Water Supply, Treatment, and Distribution," presented to the American Water Works Association, North Texas Chapter, Fort Worth, Texas, February 2001.

"Surface Water Rights Permitting Issues: Regulatory Considerations in Getting and Amending Permits," presented at the CLE International Texas Water Law Conference, Houston, Texas, May 2000.

"Water Availability Modeling and Its Impact on the Planning Process," presented at the Texas Water Law Institute, Austin, Texas, October 1998.

"Rainfall Patterns and Historical Inflows into Sabine Lake from the Sabine and Neches Rivers," presented at the Sabine Lake Conference, Orange, Texas, September 1996.

"Tarrant County Operation Model," with Jon Albright and David Marshall, U.S. Committee on Large Dams Newsletter, March 1995.

"Tarrant County Water Control & Improvement District Number One Operation Model," Advances in Model Use and Development in Water Resources, with Jon Albright and David Marshall, proceedings of the 1995 American Water Resources Association Annual Meeting and Symposium in Houston, Texas, November 1995.

"Tarrant County Water Control & Improvement District Number One Operation Model," Research Leads the Way, with Jon Albright and David Marshall, proceedings of the 24th Water for Texas Conference sponsored by the Texas Water Development Board in Austin, Texas, January 1995.

"An Overview of Stormwater Quality Management," presented at a Texas A&M University short course on Stormwater Quality Management, College Station, Texas, August 1991.

"Evaluating Effects of Proposed Instream Flow Releases for Hydroelectric Projects," Hydro Review, Kansas City, Missouri, June 1991.

"Water Supply for Texas," Texas Environmental Industry Guide, October 1990-91 Annual Issue.

Optimizing the Resources for Water Management, co-editor with Reza M. Khanbilvardi, proceedings of the 17th Annual National Conference sponsored by the Water Resources Planning and Management Division of the American Society of Civil Engineers in Fort Worth, Texas, April 1990.

"Possum Kingdom Lake: The Impact of Releases for Fish and Wildlife," presented at the ASCE Water Resources Planning and Management Division Annual Conference, Fort Worth, Texas, April 1990.

"Reallocation of Lake Texoma Water for Municipal Use," presented at the ASCE Water Resources Planning and Management Division Annual Conference, Sacramento, May 1989.

"Dam Breach Analysis of High Hazard Dams: Two Case Histories," presented at the Association of State Dam Safety Officials Annual Conference, Austin, October 1986.

"Hydrological Analyses to Determine the Existence of Unappropriated Water in Texas: A Case Study of the Paluxy River Project," with Robert S. Gooch. Presented at a Water Law Conference, University of Texas Law School, Austin, October 1985.

"Development of a Flood Management Plan," with Duncan W. Wood, Paul M. Pronovost, and David C. Noonan. A.S.C.E. Journal of Water Resources Planning and Management, October 1985.

"Flood Plain Management: A Feasible Plan for Keene, New Hampshire," with Duncan W. Wood, Paul M. Pronovost, and David C. Noonan. Presented at the ASCE National Convention, Houston, October 1983.

"History of Water Importation Plans for Texas," presented at the Texas Section ASCE Spring Convention, Fort Worth, March 1982.

Community Activities:

Massachusetts Institute of Technology

Alumni Association Board, 2003 - 2005

Educational Council, 1981 - Present

Education Council Regional Chair, 1997 - Present

Alumni Fund Board, 1997 - 2000

Class of 1977 20th Reunion Gift Chair, 1996 – 1997

Class of 1977 25th Reunion Gift Co-Chair, 2001 - 2002

Class of 1977 30th Reunion Gift Co-Chair, 2006 - 2007

Class of 1977 35th Reunion Gift Co-Chair, 2011 - 2012

Class of 1977 Class Agent, 1993 - Present

Arlington Heights United Methodist Church

Discipleship Council Chair, 2005-2006, 2013, 2015

Stewardship Chair, 2002 - 2003

Endowment Committee Chair, 1999 - 2001

Nominations Committee, 1997 - 1999

Finance Committee Chair, 1995 – 1997, 2013, 2015

Administrative Board Chair, 1993 - 1994

Administrative Board, 1988 - 1990, 1992 – 1995, 2005 - 2006

Teach High School Sunday School class, 2004 - Present

League of Women Voters

LWV-Texas Board Member, 1989 - 1993

LWV-Tarrant County President, 1986 - 1987

LWV-Tarrant County Board Member, 1982 - 1987

Leadership Fort Worth and Forum Fort Worth, 1983 - Present

Boy Scouts of America, 1987 - 1993

United Way Loaned Executive, 1983 - 1984

Allocations Subcommittee, 1993 - 1997

Fort Worth Youth Soccer Association, Coach, 1994 – 2000

PUC DOCKET NO. 45570

APPLICATION OF MONARCH UTILITIES I, L.P. TO CHANGE RATES FOR WATER AND SEWER SERVICE	§ § §	PUBLIC UTILITY COMMISSION OF TEXAS

DIRECT TESTIMONY

OF

JOHN W. HUTTS

ON BEHALF OF

MONARCH UTILITIES I, L.P.

FEBRUARY 29, 2016

DIRECT TESTIMONY OF
JOHN W. HUTTS

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DIRECT TESTIMONY OF JOHN W. HUTTS

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is John W. Hutts. My business address is 1850 Parkway Place, Suite 800, Marietta, Georgia, 30067.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by GDS Associates, Inc. ("GDS") and am a Principal of the firm.

Q. PLEASE STATE YOUR EDUCATIONAL BACKGROUND.

A. I received a Bachelor of Business Administration degree from the University of Texas at Austin in 1978 with a major in Statistics and Operations Research. I received a Master of Business Administration degree from Georgia State University in 1990 with concentrations in Finance and Decision Sciences.

Q. TO WHAT PROFESSIONAL ORGANIZATIONS DO YOU BELONG?

A. I am a member of the American Statistical Association.

Q. PLEASE STATE YOUR PROFESSIONAL EXPERIENCE AS IT RELATES TO THE UTILITY INDUSTRY.

A. From January 1980 until February 1986, I was employed by Southern Engineering Company as a statistician. My primary responsibilities included the performance of load forecasts and consumer surveys. I assisted in the preparation and evaluation of testimony and exhibits filed in a number of wholesale and retail rate cases. In

February 1986, I was employed by GDS as a Project Manager. In April 1992, I was promoted to Senior Project Manager, and in 2001 I became a Principal of the firm. My primary responsibility is the direction and management of statistical services provided by GDS. Areas of expertise include load forecasting, load research, sampling, and general statistical and data analysis. I have presented testimony before the Georgia Public Service Commission, the Public Utility Commission of Texas ("Commission"), the Oklahoma Corporation Commission, and the Michigan Public Service Commission. In addition, I have assisted in the preparation of testimony and exhibits filed in cases regarding load forecasting, weather normalization, and rate design issues. My resume is attached as Attachment JWH-1.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE A PUBLIC UTILITY COMMISSION?

A. Yes. A list of the dockets in which I have previously testified is attached as Attachment JWH-2.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING?

A. I am testifying on behalf of Monarch Utilities I, L.P. ("Monarch").

II. PURPOSE OF TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to present and support weather adjustments to Monarch's Test Year water consumption.

Q. WHY DID YOU MAKE ADJUSTMENTS TO MONARCH'S TEST YEAR BILLING DETERMINANTS?

A. I made adjustments to Monarch's Test Year billing determinants because Monarch's Test Year billing units are not representative of the weather conditions that will exist when the new rates are in effect. Therefore, adjustments are made to make the Test Year representative of normal weather conditions. Weather adjustments are made to Test Year billing determinants to represent the typical operating environment based on multi-year temperature averages.

Q. WERE YOUR TESTIMONY AND ATTACHMENTS PREPARED BY YOU OR UNDER YOUR DIRECTION?

A. Yes. This testimony and attachments were prepared by me or under my direction. The information contained in this testimony and attachments is true and correct to the best of my knowledge and belief.

Q. WHAT SCHEDULES IN THE RATE FILING PACKAGE ARE YOU SPONSORING?

A. I sponsor Schedule II-G-4.

III. SUMMARY OF DATA

Q. PLEASE DESCRIBE THE WATER CONSUMPTION DATA YOU USED FOR THE WEATHER NORMALIZATION ANALYSIS.

A. My analysis is based on monthly water consumption ("kgal") for 77 water systems for the period beginning July 2005 and ending June 2015. The data reflects billing cycle consumption rather than calendar month consumption. The data was provided by Monarch. The data for each Monarch water system included total consumption,

number of customers, and average consumption per customer. At the aggregate Monarch level, average consumption per customer is highest during the summer months and has demonstrated a decreasing trend since 2005. A summary of Test Year consumption at the Monarch level is presented in Attachment JWH-3.

Q. PLEASE DESCRIBE THE WEATHER DATA YOU USED FOR THE WEATHER NORMALIZATION ANALYSIS.

A. Weather data was obtained from AccuWeather for 29 weather stations in Texas. Data was collected on a daily basis for January 1984 through September 2015. The number of stations was determined by identifying stations closest to the headquarters for each of the 77 water systems. This matching process identified 29 weather stations. Average monthly temperature and monthly rainfall were the weather metrics used for the weather normalization analysis.

Because monthly kgal consumption was provided on a billing cycle basis, proxies of billing cycle weather were estimated by averaging weather conditions for the current and previous months. For example, estimated billing cycle weather conditions for June 2015 were computed as the average of conditions measured in calendar months June and May of 2015. A summary of Test Year weather conditions for the weighted Monarch system is presented in Attachment JWH-4.

IV. WEATHER NORMALIZATION ANALYSIS

Q. WHAT ADJUSTMENTS HAVE YOU MADE TO THE HISTORIC TEST YEAR DATA?

A. I adjusted total water consumption to account for abnormal weather that occurred during the Test Year. The adjustment to booked water sales is a decrease of 24,134 kgal.

Q. WHAT WAS THE SOURCE OF THE UNADJUSTED DATA THAT YOU USED IN PREPARING THE ADJUSTMENT?

A. The source of the unadjusted data was monthly booked number of customers, kgal sales, and average kgal consumption per customer for each water system.

Q. WHY HAS MONARCH MADE A WEATHER NORMALIZATION ADJUSTMENT TO TEST YEAR KGAL CONSUMPTION?

A. Water sales (in kgal) were adjusted to normalize Test Year sales for Monarch to reflect consumption under normal weather conditions. Adjustments are made to total consumption to ensure that the sales levels upon which rates are based do not over-recover or under-recover the utility's allowed cost of service. The weather adjusted Test Year water sales are used as the basis for setting rates on an ongoing basis. Monarch's sales will be overstated or understated depending upon whether weather conditions during the Test Year were higher or lower than normal. Traditional ratemaking requires the adjustment of Test Year kgal consumption to a level that would have occurred under normal, or average, weather conditions.

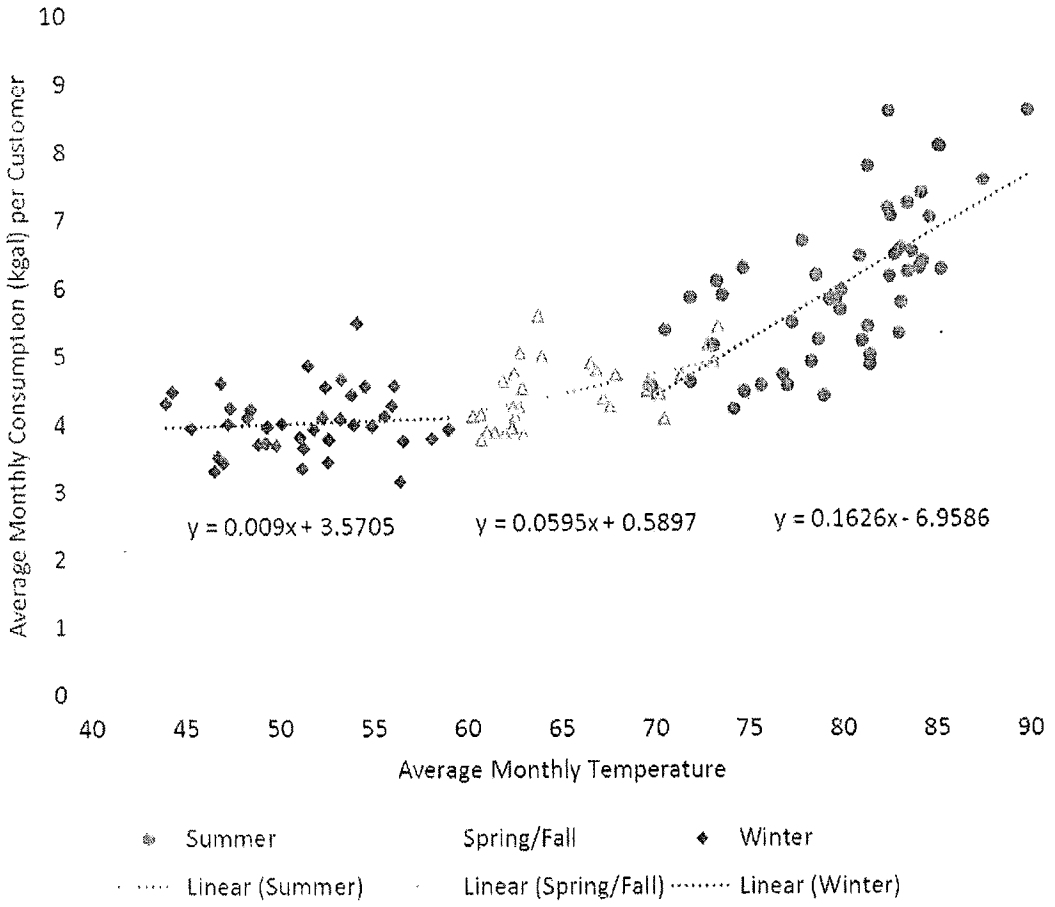
Q. HOW DO WEATHER CONDITIONS IMPACT WATER CONSUMPTION IN MONARCH'S TERRITORY?

A. My analysis shows that water consumption for the Monarch water systems is impacted by both temperature and rainfall. Water consumption increases as temperature increases, and consumption increases as rainfall decreases.

Q. PLEASE EXPLAIN HOW WATER CONSUMPTION IN MONARCH'S TERRITORY IS IMPACTED BY TEMPERATURE.

A. Water consumption increases as temperature increases, but the degree of change varies across the seasons of the year. Figure 1 presents the relationship between average consumption per customer and average temperature by month from July 2005 through June 2015. Average monthly consumption and average monthly temperature represent averages for the entire Monarch system. The relationship between consumption and temperature is positive, as consumption increases with increases in temperature. The relationship is highly significant during the summer months, less significant during the spring and fall months, and even less significance during the winter months.

Figure 1
Average Monthly Consumption (kgal) per Customer vs. Average Monthly Temperature

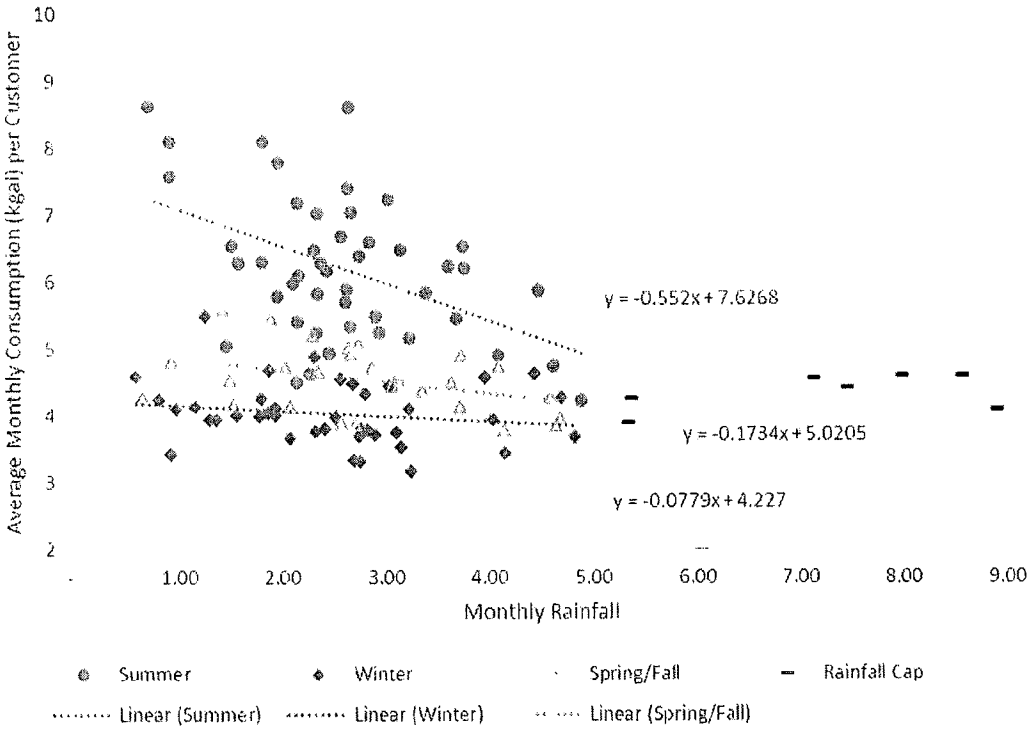


Q. PLEASE EXPLAIN HOW WATER CONSUMPTION IN MONARCH'S TERRITORY IS IMPACTED BY RAINFALL.

A. Water consumption decreases as rainfall increases, but similar to average temperature, the degree of change varies across seasons of the year. Figure 2 on the following page presents the relationship between average consumption per customer and total monthly rainfall from July 2005 through June 2015. Average monthly consumption and average monthly rainfall represent averages for the entire Monarch system. The relationship between consumption and rainfall is negative, as

consumption increases with decreases in rainfall, up to approximately 5 inches of rainfall. Beyond 5 inches of rainfall, there is no impact on average consumption. Similar to the relationship between consumption and temperature, the relationship between consumption and rainfall, up to 5 inches, is highly significant during the summer months, less significant during the spring and fall months, and even less significant during the winter months.

Figure 2
Average Monthly Consumption (kgal) per Customer vs. Monthly Rainfall



Q. PLEASE DESCRIBE THE WEATHER CONDITION EXPERIENCED DURING THE TEST YEAR.

A. Average temperature during the entire Test Year was not significantly different from normal, where normal temperature is represented as the average for the most recent 30 years. Average temperature during the summer, spring, and fall months of the

Test Year were slightly higher than normal, while average temperature during the winter months of the Test Year was lower than normal. Rainfall during the entire Test Year was lower than normal, where normal rainfall is represented as the average for the most recent 30 years. Average rainfall was slightly lower than normal during the summer months, lower than normal during the winter months, and higher than normal during the combined spring and fall months.

Q. PLEASE DESCRIBE THE METHOD YOU USED TO DEVELOP MONARCH'S WEATHER NORMALIZATION ADJUSTMENT.

A. I developed the weather normalization adjustment through a statistical analysis that included the development of regression models. Regression models are used to estimate a variable of interest by quantifying the relationship between that variable and one or more influential, or independent, variables. The model I developed quantifies the relationship between monthly water consumption, average temperature, and rainfall. Values for monthly rainfall were capped at 5 inches. A time trend is also included to capture the decline in average consumption per customer over time, and monthly binary variables are included to differentiate consumption across months due to factors beyond weather conditions. Finally, an autoregressive parameter is included to address the existence of first-order autocorrelation, which is evident in many time series models. Given the varying impacts of temperature and rainfall on consumption across seasons, three seasonal temperature and rainfall parameters were included in the model.

Monthly data covering July 2005 through June 2015 for each of 77 water systems was used in developing a fixed effects panel model.[1] The model incorporates panel data (time series data for multiple water systems) and controls for fixed effects, or differences in average water consumption across the 77 water systems. Such differences in average consumption across systems are due primarily to customer class composition, but other factors could include home size, water restrictions, or conservation practices.

Specification of a panel model provided the means for utilizing data for all 77 water systems. The model was estimated using 9,163 observations, which provided for the estimation of coefficients with very low standard errors. The model output is provided as Attachment JWH-5. Review of the model coefficients indicates that the average temperature and rainfall coefficients are highly significant, as evidenced by p-values that are less than the 0.05 alpha level for each parameter. Each parameter demonstrates the theoretically correct relationship with monthly water consumption, as witnessed by the positive coefficients for the average temperature parameters and negative coefficients for the rainfall parameters. The differences in magnitude between the average temperature coefficients are consistent with the pre-modeling analysis showing that average temperature during the summer months impacts water consumption more than temperature during the fall and spring (valley) months, which impacts water consumption more than temperature during the winter months. Likewise, the differences in magnitude between the rainfall coefficients are consistent with the pre-modeling analysis showing that rainfall during the summer months

[1] Data for one system was available for only the August 2014 to June 2015 period.

impacts water consumption more than rainfall during the fall and spring months, which impacts water consumption more than rainfall during the winter months.

Q. DID YOU CONSIDER OTHER MODEL SPECIFICATIONS INSTEAD OF THE FIXED EFFECTS PANEL MODEL?

A. I tested individual models for each water system, and I tested a model where the system data was aggregated to the total Monarch level. Models at the individual system level produced inconsistent results. In some instances, the temperature and rainfall coefficients were not statistically significant at even the 0.10 and 0.20 alpha levels and carried the wrong positive or negative sign. Additionally, the magnitude of the seasonal average temperature and rainfall coefficients were illogical in many cases. The model developed using aggregate Monarch system data produced reasonable results, but the coefficients and associated statistics were not nearly as strong as the panel model. Output for the model developed using the aggregate Monarch data is provided as Attachment JWH-6.

Q. PLEASE PROVIDE EVIDENCE FOR USING THE RAINFALL CAP IN THE MODELING PROCESS.

A. The data I presented in Figure 2 above demonstrates how water consumption shows no impact from rainfall once rainfall reaches a level of 5 inches in a month. The practice of capping rainfall for modeling purposes with respect to average water consumption has been a common practice with SWWC companies in California and is recommended by the California Public Utilities Commission.[2]

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[2] California Public Utilities Commission, Utilities Division, Hydraulic Branch, Guide for Adjusting and Estimating Operating Revenues of Water Utilities, Standard Practice No. U-25, April 1968.

Q. HOW WERE NORMAL VALUES FOR TEMPERATURE AND RAINFALL COMPUTED?

A. Normal temperature and rainfall values were computed for each water system by month and based on the arithmetic average of values from the 30 years ending June 2014. Use of 30-year normal weather is consistent with weather normalization analyses recently completed by SWWC and filed before the California Public Utilities Commission.[3] Thirty-year normal values are appropriate as they are consistent with the basis upon which the National Climatic Data Center reports normal weather. As described earlier in my testimony, calendar month values were converted to billing cycle amounts by averaging values for the current and previous month.

Q. PLEASE DESCRIBE HOW THE TEST YEAR WEATHER ADJUSTMENT WAS COMPUTED USING THE MODELING RESULTS.

A. The weather adjustment was computed for each system and each month of the Test Year as the product of the coefficient for the respective weather parameter in the model and the difference between the normal and actual weather variable. An example of the calculation for one system for June 2015 is presented in Attachment JWH-7.

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[3] Order Instituting Rulemaking on the Commission's Own Motion to Evaluate Existing Practices and Policies for Processing General Rate Cases and to Revise the General Rate Case Plan for Class A Water Companies, Interim Order Adopting Rate Case Plan, Appendix page 6, June 9, 2004.

Q. WHAT WAS THE EFFECT OF THE WEATHER ADJUSTMENT ON TOTAL TEST YEAR WATER CONSUMPTION?

A. Overall, considering the weather metrics that impact water consumption and the varying impacts of these metrics during the year, weather during the Test Year was more extreme than normal, and the magnitude of the weather normalization adjustment is a reduction of 24,134 kgal, or approximately 2.1 percent.

Q. HAVE YOU DETERMINED THE REASONABLENESS OF THE WEATHER ADJUSTMENTS PROPOSED BY MONARCH IN THIS PROCEEDING?

A. Yes. I have reviewed the regressions, the weather data, and the calculation of the weather normalization adjustments, and have found the weather adjustments to be within an acceptable range of reasonableness and accuracy based on long-standing statistical standards in the industry.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes, it does.

John W. Hutts
Principal

EDUCATION: Master of Business Administration, Georgia State University, 1990
Concentration: Finance and Decision Sciences
Bachelor of Business Administration, The University of Texas at Austin, 1978.
Concentration: Statistics and Operations Research

PROFESSIONAL MEMBERSHIP: American Statistical Association (ASA)

EXPERIENCE:

1986-Present GDS Associates, Inc.

GDS principal whose responsibilities include the direction of statistical services provided by GDS and supervision of supporting project staff. Areas of expertise include long-term and short-term forecasting, sample design, consumer surveys, load research, weather normalization, database management, and decision support systems.

1980-1986 Southern Engineering Company

Responsibilities included participation and project management of projects focusing on statistical applications, including load forecasts and consumer surveys.

Specific Project Experience Includes:

Energy Forecasting

- Designed, implemented and currently manages load forecasting systems for fourteen electric utilities in Texas. Forecasting systems provide long-term (15 year) and short-term (12-month) forecasts for resource and financial planning and are supported by a network of econometric and end-use models. Consumer attitude and appliance saturation surveys are conducted every three years. Outputs of the system include load forecast reports, consumer surveys, oral/written testimony when required, and documentation to regulatory agencies.
- Developed load forecasts for electric utility systems in Alabama, Alaska, Georgia, Kentucky, Louisiana, Illinois, Indiana, Mississippi, North Carolina, Ohio, South Carolina, Texas, and Virginia. Methodologies included econometric modeling, neural networks, end-use modeling, trending, and delphi techniques.
- Performed load forecasting process audits for electric utilities in the Canadian provinces of Nova Scotia, New Brunswick, and British Columbia.
- Designed day-ahead load forecasting systems for electric utilities in Kentucky, Texas, and Louisiana. The forecasting systems automatically update historical and forecasted weather data and generate hourly load projections for up to 168 hours. Forecasting models were based on neural network systems and transferred to the clients' computer systems.
- Filed testimony before state regulatory commissions regarding load forecasting issues in rate cases and integrated resource plan filings.

Statistical Services

- Conducted load research studies and analyses for utilities in Georgia, Texas, South Carolina, and Florida.
- Filed testimony before state regulatory commissions regarding weather normalization.

- Developed a probabilistic modeling system for an electric cooperative in Texas to simulate market conditions with respect to fuel charges incurred under a power supply contract. The system was developed using Crystal Ball software, incorporates Monte Carlo simulation techniques, and provides information used for natural gas price hedging analysis. The system provides the means of analyzing the uncertainty associated with monthly fuel expense due to natural gas price volatility.

Research/Consumer Surveys

- Managed residential consumer survey projects for utilities in Texas, Colorado, South Carolina, and Alabama. Projects included questionnaire design, sample design, data cleaning, data tabulation, analysis of results, and report preparation. Developed applications software to select stratified random sample (Dalenius/Hodges and optimum allocation), produce mailing labels, tabulate responses, and calculate confidence bands by stratum and by total sample. Software was developed using the Statistical Analysis System (SAS) software package.
- Managed various projects and consulting services provided to an Atlanta, Georgia based marketing services firm conducting research in the retail industry. Primary areas of service included sample design, sample selection, benchmarking of results, and various unique analyses. Specific services provided include: definition of consumer market trade areas, development of survey questionnaires, implementation of data processing procedures, development of sampling methodology, interpretation of survey results, development of total portfolio benchmarks, and preparation of final survey reports. Developed a process for merging economic/demographic data (sources: U.S. Census and Bureau of Economic Analysis) with survey data. Developed models used to estimate average consumer expenditure in response to influential characteristics, including: area of residence, average household income, age, and gender. Managed development of comprehensive database and series of industry benchmarks.
- Managed consulting services provided to a Washington, D.C. based marketing research firm. Primary areas of service focused on project management, statistical issues and analytical expertise regarding employee satisfaction surveys conducted for a major international hotel chain. Managed processes regarding data tabulation, interpretation of results, and reporting. Produced trend reports for surveys conducted over time. Reports and other deliverables were provided electronically via pdf files.
- Managed market research services provided to a Marietta, Georgia based research firm. Provided sampling and analytical expertise for research conducted in the commercial development, banking, and retail industries.
- Provided consumer survey services to a Marietta, Georgia based consulting firm for a series of surveys administered to banking customers at branches located throughout the north Georgia area. Provided cross-tabulations of survey results, developed local demographic and economic profiles of households located in the branch areas, and created indexes as a means of comparing banking customers to the general population.
- Managed the sample design phases for multiple research projects performed by GDS to measure program impacts for various demand-side and energy efficiency studies.

TRAINING SEMINARS CONDUCTED:

1. Load Forecasting Techniques: Georgia Public Service Commission Staff
2. Econometric Modeling using SAS: Public Service Authority of South Carolina
3. Customer Surveys in the Retail Industry: Morris & Fellows, Inc.

John W. Hutts
List of Previously Filed Testimony

Date	Regulatory Agency	Docket	Utility Involved
May-2013	Texas Public Utilities Commission	DOCKET NO. 41474	Sharyland Utilities, L.P.
May-2013	Georgia Public Service Commission	DOCKET NO. 36498	Georgia Power Company
Nov-2011	Georgia Public Service Commission	DOCKET NO. 34218	Georgia Power Company
Apr-2011	Michigan Public Service Commission	Case No. U-16472	Detroit Edison
Oct-2010	Georgia Public Service Commission	DOCKET NO. 31958	Georgia Power Company
Jun-2010	Georgia Public Service Commission	DOCKET NO. 29489	Georgia Power Company
May-2010	Georgia Public Service Commission	DOCKET NO. 31081	Georgia Power Company
Jul-2009	Michigan Public Service Commission	Case No. U-15768	Detroit Edison
Dec-2008	Georgia Public Service Commission	DOCKET NO. 27800	Georgia Power Company
Mar-2008	Michigan Public Service Commission	Case No. U-15290	Consumers Energy
May-2002	Corporation Commission of the State of Oklahoma	Cause No. PUD 200100455	Oklahoma Gas & Electric Company
Mar-2002	Georgia Public Service Commission	DOCKET NO. 14618-U	Savannah Electric & Power Company
Oct-2001	Georgia Public Service Commission	DOCKET NO. 14000-U	Georgia Power Company
May-1998	Georgia Public Service Commission	DOCKET NO. 8708_U and 8709-U	Georgia Power Company
Nov-1994	Public Utility Commission of Texas	DOCKET NO. 12065	Houston Lighting & Power
Nov-1994	Public Utility Commission of Texas	DOCKET NO. 11735	Texas Utilities Company
Feb-1993	Michigan Public Service Commission	Case No. U-10102	Detroit Edison
Nov-1992	Michigan Public Service Commission	Case No. U-10127	Consumers Power Company
Jun-1986	Public Utility Commission of Texas	DOCKET NO. 6735	Wood County Electric Cooperative

Monarch Water, L.P.
Summary of Test Year Weather Adjustments

	Actual	Weather Adjustment	Adjusted Test Year
Jul-14	117,685	3,089	120,774
Aug-14	127,569	(837)	126,732
Sep-14	110,873	(10,490)	100,383
Oct-14	99,439	(18,274)	81,166
Nov-14	85,646	(1,512)	84,133
Dec-14	83,316	(981)	82,335
Jan-15	81,790	(1,102)	80,688
Feb-15	73,372	1,064	74,436
Mar-15	84,044	652	84,696
Apr-15	85,421	448	85,869
May-15	90,738	1,072	91,810
Jun-15	101,951	2,737	104,688
	1,141,843	(24,134)	1,117,710

Monarch Water, L.P.
Summary of Test Year Weather Adjustments

	Actual Average Temperature	Actual Rainfall	30-Year Normal Average Temperature	30-Year Normal Rainfall
Jul-14	81.43	3.69	82.11	3.69
Aug-14	83.16	1.96	83.71	2.78
Sep-14	81.52	1.47	80.51	3.21
Oct-14	74.85	2.15	72.23	4.05
Nov-14	62.07	2.71	62.12	4.08
Dec-14	52.70	2.33	52.74	3.58
Jan-15	48.90	2.75	47.99	3.36
Feb-15	46.55	2.75	49.31	3.26
Mar-15	52.65	2.83	54.81	3.44
Apr-15	63.03	4.64	62.40	3.47
May-15	70.56	8.91	70.13	4.03
Jun-15	77.11	8.58	77.27	4.70

Monarch Water, L.P.
Regression Model Output - Fixed Effects Panel Model

Dependent Variable: KGAL
Method: Panel Least Squares
Date: 11/09/15 Time: 08:10
Sample (adjusted): 2005M08 2015M06
Periods included: 119
Cross-sections included: 77
Total panel (balanced) observations: 9163
Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.594129	0.536617	6.697752	0.0000
TREND	-0.008620	0.000776	-11.11440	0.0000
AVGTEMP_SUMMER	0.233035	0.014737	15.81306	0.0000
AVGTEMP_WINTER	0.025701	0.010975	2.341672	0.0192
AVGTEMP_VALLEY	0.090972	0.014317	6.353991	0.0000
RFCAP_SUMMER	-0.164269	0.021842	-7.520786	0.0000
RFCAP_WINTER	-0.047698	0.024257	-1.966326	0.0493
RFCAP_VALLEY	-0.089175	0.022627	-3.941084	0.0001
M2	-0.277417	0.064168	-4.323277	0.0000
M3	-0.408189	0.106778	-3.822768	0.0001
M4	-4.374726	0.911537	-4.799283	0.0000
M5	-4.549145	1.000138	-4.548519	0.0000
M6	-15.44331	1.264178	-12.21609	0.0000
M7	-15.65330	1.328630	-11.79929	0.0000
M8	-15.73064	1.343188	-11.71142	0.0000
M9	-15.42013	1.306444	-11.80313	0.0000
M10	-14.21165	1.191211	-11.93043	0.0000
M11	-4.099024	0.898389	-4.562639	0.0000
M12	-0.054274	0.084913	-0.639175	0.5227
AR(1)	0.410998	0.009065	45.33716	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.702292	Mean dependent var	4.972973
Adjusted R-squared	0.699173	S.D. dependent var	2.697405
S.E of regression	1.479465	Akaike info criterion	3.631660
Sum squared resid	19846.01	Schwarz criterion	3.706286
Log likelihood	-16542.45	Hannan-Quinn criter.	3.657031
F-statistic	225.1475	Durbin-Watson stat	2.147911
Prob(F-statistic)	0.000000		
Inverted AR Roots	.41		

TREND = Time trend
AVGTEMP_SUMMER = Average monthly dry bulb temperaure during summer months (Jun.-Oct.)
AVGTEMP_WINTER = Average monthly dry bulb temperature during winter months (Dec.-Mar.)
AVGTEMP_VALLEY = Average monthly dry bulb temperature durin valley months (Apr., May, Nov.)
RFCAP_SUMMER = Total monthly rainfall (capped at 5 inches) during summer months (Jun.-Oct.)
RFCAP_WINTER = Total monthly rainfall (capped at 5 inches) during winter months (Dec.-Mar.)
RFCAP_VALLEY = Total monthly rainfall (capped at 5 inches) during valley months (Apr., May, Nov.)
M2 - M12 = Binary variables indicating month of year
AR(1) = Autoregressive parameter

Monarch Water, L.P.
Regression Model Output - Aggregate Monarch Model

Dependent Variable: AVGUSE
Method: Least Squares
Date: 11/22/15 Time: 14:53
Sample (adjusted): 2005M08 2015M06
Included observations: 119 after adjustments
Convergence achieved after 14 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.898092	1.665127	3.542127	0.0006
TREND	-0.008402	0.001963	-4.281231	0.0000
DB_S	0.221101	0.052958	4.175071	0.0001
DB_W	-0.019819	0.034009	-0.582766	0.5614
DB_V	0.044858	0.046775	0.958997	0.3399
RF_S	-0.182327	0.080164	-2.274441	0.0251
RF_W	-0.111096	0.078564	-1.414096	0.1605
RF_V	-0.159109	0.068273	-2.330495	0.0218
M2	-0.298762	0.163043	-1.832417	0.0699
M3	-0.087323	0.302033	-0.289116	0.7731
M4	-3.384186	3.164734	-1.069343	0.2875
M5	-3.332326	3.460830	-0.962869	0.3380
M6	-16.67565	4.615556	-3.612923	0.0005
M7	-16.85885	4.842257	-3.481610	0.0007
M8	-17.03004	4.900245	-3.475344	0.0008
M9	-16.70694	4.763289	-3.507438	0.0007
M10	-15.70966	4.350902	-3.610667	0.0005
M11	-3.308953	3.119901	-1.060596	0.2915
M12	0.172561	0.237618	0.726211	0.4694
AR(1)	0.405819	0.087063	4.661216	0.0000

R-squared	0.891228	Mean dependent var	4.958717
Adjusted R-squared	0.870352	S.D. dependent var	1.180931
S.E. of regression	0.425214	Akaike info criterion	1.279681
Sum squared resid	17.89987	Schwarz criterion	1.746761
Log likelihood	-56.14103	Hannan-Quinn criter.	1.469348
F-statistic	42.69251	Durbin-Watson stat	1.784757
Prob(F-statistic)	0.000000		

Inverted AR Roots	.41

TREND = Time trend
DB_S = Average monthly dry bulb temperaure during summer months (Jun.-Oct.)
DB_W = Average monthly dry bulb temperature during winter months (Dec.-Mar.)
DB_V = Average monthly dry bulb temperature durin valley months (Apr., May, Nov.)
RF_S = Total monthly rainfall (capped at 5 inches) during summer months (Jun.-Oct.)
RF_W = Total monthly rainfall (capped at 5 inches) during winter months (Dec.-Mar.)
RF_V = Total monthly rainfall (capped at 5 inches) during valley months (Apr., May, Nov.)
M2 - M12 = Binary variables indicating month of year
AR(1) = Autoregressive parameter