APPENDIX A

DEVELOPMENT OF LOCAL SYSTEM INDICATORS

The indicators used in the Plan were developed to provide guidelines for the Water Director to:

- determine the level of drought response needed in the Tucson Water service area;
- evaluate the potential impacts drought might have on availability of water supplies or the Utility's ability to deliver water to customers; and
- implement the response actions needed to mitigate potential impacts.

To accomplish this, drought indicators must be meaningful and measure something that is:

- critical to Tucson Water's ability to deliver water (including water supply availability and potential system impacts specific to our water system);
- useful for good resource management practices; and
- not already measured by another indicator (i.e. not repetitive or a variable included in another indicator).

Because Tucson Water uses both imported surface water and groundwater for potable supply, the Plan's indicators needed to reflect potential drought impacts to either or both of these supplies. This consideration resulted in development of both regional indicators and local system indicators. Regional indicators, as described in Chapter 3, reflect potential reductions in availability of Colorado River water as well as watershed conditions for our local area monitored and reported by the Arizona Department of Water Resources (ADWR). Local system indicators reflect potential impacts specific to Tucson's water system and groundwater supplies. Tucson Water's Plan includes 3 local system indicators and one additional indicator that will be used primarily as a "response monitoring tool".

Whereas regional indicators are outside the control or influence of Tucson Water, usually reflecting watershed related conditions, the Utility can generally exercise more direct control in responding to local system indicators. Tucson Water staff routinely evaluates a number of variables to examine the performance of the potable and reclaimed systems. However, monitoring and analyzing these variables in terms of their relationship to drought will provide early warning of potential drought related system problems that can signal the need to implement mitigation measures to avoid those problems.

The local system indicators give a general view of the overall "health" of the water systems, with each one reflecting the influence of a number of possible impacts of drought. A downward trend in any of the indicators would be a signal to the Director that

a more in-depth evaluation of system components is needed or that specific response measures should be implemented.

Potable Water Production Capacity Index (PPCI)

The PPCI indicator is a ratio of potable production capacity to potable demand. In this equation, demand is the forecasted total potable water demand for the average day of the peak 30-day period for the upcoming summer. Production capacity in this equation is the expected capability to produce and deliver water to adequately meet the upcoming summer demand over the entire maximum 30-day period – this will be less than the sum of the capacity of all the individual wells. PPCI measures the Utility's overall ability to produce sufficient water to meet peak demand.

Production capacity in the PPCI ratio is largely determined based on well efficiency measures, including such factors as system pressures, static water levels, specific well capacity and so forth. Tucson Water's integrated potable system is generally designed to provide supply in excess of the average day of the peak 30-day period. Tucson Water will monitor this index both for its absolute value and for its trend in each of the potable systems. A high value trending downward or a low value that is not showing signs of improving will likely warrant operational response actions such as expedited system maintenance or well drilling programs.

Gallons Per Capita Per Day (GPCD)

"Gallons per capita per day water use", or GPCD, has been tracked by the utility for a number of years to ensure compliance with ADWR regulations. GPCD was incorporated into the Plan as a local system indicator that will be used primarily as a "response monitoring tool" when a drought response stage is declared for the Tucson Water service area. Per capita water use is simply total potable demand, including lost and unaccounted for water, divided by the population and by the number of days in the year.

Under normal climatic conditions, GPCD would be expected to remain stable. One of the anticipated effects of local drought is an increase in GPCD because customers traditionally tend to use more water when it is hotter and drier than normal. Monitoring GPCD will help determine if there is a demand response to the drought –increases due to drought conditions or decreases corresponding to water conservation or drought specific programs.

The Potable Production Capacity Index (PPCI) will capture increases in total demand or reductions in capacity during the peak demand periods. Given anticipated expansion of

production capacity, however, a local drought will likely not result in demand exceeding production capacity (as measured by the PPCI) even if GPCD were to increase.

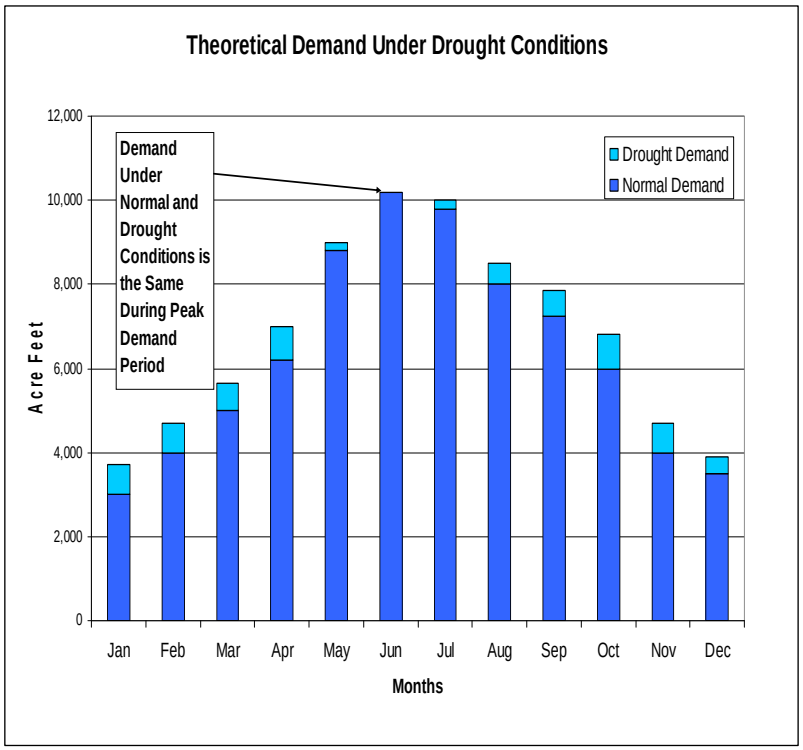

Figure A.1: Theoretical Demand under Drought Conditions

In fact, GPCD could go up as a result of increased demand during the winter and shoulder months (March, April and September, October) rather than during the maximum 30- day (peak) demand period, which can be generally characterized as "drought-like" even under normal climate conditions. Therefore, if the PPCI were the only indicator incorporating demand, the drought plan would fail to address potential drought related impacts of increased GPCD. An example of those potential impacts might include more groundwater being used than under normal climate conditions, which in turn would result in more rapid use of our Allowable Groundwater Credits and would potentially contribute to a more rapid decline in the water table. (See Figure A.1)

Aquifer Storage Index (ASI)

The "health" of the aquifers from which Tucson Water pumps groundwater can be measured in a number of ways. Aquifer health, regional water table elevations, and the number and depth of wells can all impact the overall productivity of a well field. In addition, drought conditions on the Colorado River could lead to decreased CAP deliveries to the City's recharge and recovery projects. While the design of the recharge projects allow for continued pumping with reduced or no recharge for a considerable time, doing so over sustained periods could negatively impact the productive capacity of those well fields.

When considering drought impacts, changes to the regional water table in the most productive well fields are of prime concern. Tucson Water developed the ASI to capture changes in static water level conditions to provide a measure of changes in the aquifer that could influence water supply.

The ASI is an annual measure which indicates a change in groundwater levels by comparing groundwater levels with those in a particular (index) year. The groundwater levels are taken from individual, spatially-distributed wells and summed to produce a total for the year. The water levels are weighted by the volume pumped. The total for the current year is divided by the total for the index year of 2000 to derive the ASI. (The year 2000 was selected because it represents the condition of the aquifer immediately prior to the introduction of CAP water at the CAVSARP facility, following many years of continuous groundwater pumping.) A prolonged local and/or regional drought would be expected to decrease water levels in the aquifer, which in turn could eventually affect the productivity of the well fields.

Reclaimed Production Capacity Index (RPCI)

The RPCI indicator is a ratio of reclaimed production capacity to reclaimed demand, very similar to the PPCI. Tucson Water's reclaimed system is generally designed to be 2.0 times the average day of the peak month. The design standard for the reclaimed system is different than the standard for the potable system because reclaimed demand is primarily related to irrigation needs and is, therefore, more responsive to climatic conditions and has higher "peak demand" requirements.

A probable outcome of local drought is an increase in demand for reclaimed water from existing and new customers that could negatively impact the system's ability to meet that demand unless capacity (infrastructure enhancement) keeps pace. A downward trend in the RPC will be considered along with other drought indicators to determine appropriate drought response.

APPENDIX B
TUCSON WATER BASELINE CONSERVATION PROGRAM

- General public information programs (Beat the Peak, speaker's bureau, presence at community events, distribution of bill inserts).

- Education and training programs (annual teacher internship training, water audit training for landscapers).

- Rebates and other incentive-type programs.

- Direct assistance programs (Zanjeros audit program, Water Smart irrigation workshops for homeowners, Smartscape workshops for landscapers).

- Regulatory measures (landscaping and water waste ordinances, plumbing codes).

- Increasing block water rate structure.

.

- Participate in or sponsor water conservation-related research projects.

APPENDIX C

RELATED CITY PLANS, ORDINANCES, AND POLICIES

Plans:

City of Tucson Water Department, 2004. *Water Plan: 2000-2050 (Final Draft).*

City of Tucson Water Department, 2008. *Water Plan 2000-2050, 2008 Update*

City of Tucson Water Department, 1997. *Tucson Water Emergency Response Plan.*

Ordinances:

City of Tucson, 1995. *Ordinance 8461*, Relating to Water; establishing the City of Tucson Emergency Water Conservation Response Plan; amending the Tucson Code by adding a new article VI, Emergency Conservation Response, and by adding new sections 27-90 through 27-99 to the Tucson Code.

Policies:

City of Tucson, 1998. *Mayor and Council Water Policies* (Roman Numeral 3, Policies; Section C., Water Supply Management, and Development, Number 2--Contingency Plans).

APPENDIX D

REFERENCES

American Water Works Association (AWWA), 2002. *Drought Management Handbook* AWWA Water Shortage Subcommittees, AWWA Water Conservation Committee

Arizona Department of Water Resources, 2006 *System Water Plan Guidance Document* www.water.az.gov/dwr

Arizona Department of Water Resources, 2006 *Drought Monitor Report (*various issues), Governor's Task Force Monitoring Technical Committee

Arizona Governor's Drought Task Force, Governor Janet Napolitano, 2004. *Arizona Drought Preparedness Plan, Operational Drought Plan*

Arizona Hydrological Society Symposium, 2006 *Climate Change and Drought Workshop,* Glendale Civic Center, Glendale, Arizona

City of New York, 1998 *Drought Management Plan and Rules* City of New York Department of Environmental Protection

City of Peoria, Arizona, 2003 *Drought Contingency Plan* City of Peoria Utilities Department, Water Resource and Conservation Division

City of Phoenix, Arizona, 2000 *Drought Management Plan* City of Phoenix Water Services Department

City of Scottsdale, Arizona (not dated) *Drought Management Plan* City of Scottsdale Water Department

City of Tucson Water Department, 2004 *Water Plan: 2000-2050 (Final Draft)*

City of Tucson Water Department, 2008 *Water Plan 2000-2050, 2008 Update*

Climate Assessment for the Southwest (CLIMAS) Project; University of Arizona Cooperative Extension 2006 *Southwest Climate Outlook* (various issues) CLIMAS web site www.ispe.arizona.edu/climas

National Drought Mitigation Center, U.S. Drought Monitor web site: www.drought.unl.edu/dm/monitor.html

Pima County, Arizona, 2006 *Pima County Drought Management Plan* (draft)

Southern Nevada Water Authority, 2005 *Drought Plan* (supplement to the Authority's Water Resource Plan.*)*

APPENDIX E

ORDINANCE 10380

(Editor's Note: The City of Tucson Mayor and Council unanimously approved the drought response plan November 28, 2006. The implementing ordinance was subsequently adopted March 20, 2007.)

See next page.

ADOPTED BY THE
MAYOR AND COUNCIL

March 20, 2007

ORDINANCE NO. 10380

RELATING TO WATER; AMENDING THE TUCSON CODE, CHAPTER 27, WATER, BY ADDING A NEW ARTICLE VIII, DROUGHT PREPAREDNESS AND RESPONSE PLAN; AND DECLARING AN EMERGENCY.

BE IT ORDAINED BY THE MAYOR AND COUNCIL OF THE CITY OF TUCSON, ARIZONA, AS FOLLOWS:

SECTION 1. The Tucson Code Chapter 27 is amended to add a new Article VIII, as follows:

ARTICLE VIII. DROUGHT PREPAREDNESS AND RESPONSE PLAN

Sec. 27-110. Purpose.

This article establishes a city drought preparedness and response plan.

Sec. 27-111. Declaration of policy.

It is hereby declared that, because of varying conditions related to water resource supply and distribution system capabilities during drought, it is necessary to establish and to enforce drought response stages and drought response measures to ensure that the water resources available to the city are put to the maximum beneficial use; that unreasonable use, or unreasonable method of use is prevented; and that conservation of water is accomplished in the interests of the customers of the city and for the public health, safety, and welfare.

Sec. 27-112. Application.

(a) This article applies to all departments of the city, and to all city water customers who own, occupy, or control water use on any premises as defined in section 27-10.

(b) No person shall make, cause, use, or permit the use of water received from the Department for residential, commercial, industrial, governmental or any other purpose in any manner contrary to any provision in this article.

(c) Mandatory drought response measures shall be implemented based upon the declaration of drought response stages pursuant to section 27-115.

Sec. 27-113. Declaration of drought response stages, implementation, termination.

(a) Stage 1 or Stage 2 drought response will be declared by the City Manager, or any designee, on the advice of the Director. A Stage 3 or Stage 4 drought response will be declared by the Mayor and Council, or any designee, upon the recommendation of the City Manager.

(b) The Director shall develop guidelines which set forth general criteria to assist the City Manager or Mayor and Council, or any designee, in determining drought response stages.

(c) Following the declaration of any drought response stage, the Department will implement appropriate response actions, including but not limited to public notification and various drought response measures.

(d) The Director will continually monitor drought conditions and promptly recommend that the drought stage level increase if conditions worsen. Similarly, the Director will advise the City Manager to rescind Stage 1 or 2, or to recommend termination of Stage 3 or 4, if warranted by lessened drought conditions.

Sec. 27-114. Triggers for each drought response stage.

Each drought response stage will be triggered by specific conditions related to the availability of Colorado River water and/or local water system indicators, such as well and distribution system operating capacities:

(a) Stage 1 trigger: A severe and sustained drought on the Colorado River watershed and/or any declaration of drought status above normal in the Santa Cruz Watershed by the Arizona Drought Monitoring Technical Committee.

(b) Stage 2 trigger: A declaration by the Secretary of the Interior of a shortage on the Colorado River that results in a reduction in Central Arizona Project (CAP) water deliveries to agricultural, other non-municipal users, or to excess users, OR, a deterioration in local water system

indicators in conjunction with a drought status above normal for the Santa Cruz Watershed.

(c) Stage 3 trigger: Continuing shortages on the Colorado River resulting in reductions in CAP deliveries to municipal subcontractors, including the city, OR, a further deterioration in local water system indicators in conjunction with a drought status above normal for the Santa Cruz Watershed.

(d) Stage 4 trigger: Additional reductions to CAP municipal deliveries, a further deterioration of local system indicators, and/or a failure to significantly reduce water demand in Stage 3.

Sec. 27-115. Response actions for each drought response stage.

Upon declaration of a drought response stage the Director shall be authorized to implement and enforce any or all of the drought response measures for a specific drought response stage included in the last-adopted Drought Preparedness and Response Plan on file with the City Clerk's Office.

Sec. 27-116. Variances.

The Director, or the Director's designee, is authorized to review special cases within which strict application of this chapter would result in serious hardship to a customer. A variance may be granted only for reasons involving health, safety or economic hardship. Application for variance from requirements of this article must be made on a form provided by the Director. The Department may charge a fee to process a variance request.

Sec. 27-117. Violation.

(a) Violations of this article will result in a written notice placed on the property where the violation occurred. A duplicate will be mailed to the person who is regularly billed for the service where the violation occurs and to any person known to the Department who is responsible for the violation or its correction. The notice will describe the violation and order that it be corrected, ceased or abated immediately or within such specified time as the Department determines is reasonable under the circumstances. The notice of violation will contain a description of the possible fees and penalties associated with said violation. If the order is not complied with, the Department may disconnect the service where the violation occurs and the then current disconnection charge will be applied to the customer account. Reconnection of any service disconnected for non-compliance will require payment of the then current complete new service connection charge in addition to other fees or charges imposed by this ordinance for disconnection of service.

(b) In addition to being grounds for discontinuation of service, violation of any provision of this article shall be a civil infraction. An individual or corporation convicted of violating provisions of this section shall be assessed a civil penalty of not less than two hundred fifty dollars ($250.00) or more than one thousand dollars ($1,000.00) per violation.

Sec. 27-118. Enforcement.

This article will be enforced by the Department. The City Manager, in consultation with the Director, is authorized to designate additional city employees to assist in enforcement, should conditions warrant.

Sec. 27-119. Definitions.

Department means the City of Tucson Water Department (Tucson Water).

Director means the Director of the City of Tucson Water Department.

Economic hardship means a threat to a primary source of income for an individual or business.

Notification to public means notification through local media, including interviews and issuance of news releases and/or Department bill inserts.

SECTION 2. If any Section, Subsection, Sentence, Clause, Phrase, or Portion of this Ordinance is for any reason held to be invalid or unconstitutional by the decision of any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions thereof.

SECTION 3. The various City officers and employees are authorized and directed to perform all acts necessary or desirable to give effect to this ordinance.

SECTION 4. WHEREAS, it is necessary for the preservation of the peace, health, and safety of the City of Tucson that this Ordinance become

. . .

. . .

immediately effective, an emergency is hereby declared to exist and this ordinance shall be effective immediately upon its passage and adoption.

PASSED, ADOPTED AND APPROVED BY THE MAYOR AND COUNCIL OF THE CITY OF TUCSON, ARIZONA, March 20, 2007.

MAYOR

ATTEST:

CITY CLERK

APPROVED AS TO FORM:

CITY ATTORNEY

REVIEWED BY:

CITY MANAGER

CA:dc
03/06/2007 12:55 PM

APPENDIX F
VARIANCE APPLICATION
FROM
CITY OF TUCSON WATER DEPARTMENT
DROUGHT PREPAREDNESS PLAN
ORDINANCE NO. 10380 REQUIREMENTS

SECTION I. General Information

1. **Applicant Name:**_____
2. **Customer Name**
3. **(*if different from 1.)*:**_____
4. **Service Address:**_____
5. **Account Number(s)**_____
6. **Daytime Contact:**
   - **Name:**_____
   - **Address**_____
   - **Affiliation:**_____
   - **Telephone Number(s)**_____

SECTION II. Variance Request

Article VI, Section 27-96 of the Tucson Code states: "The City Manager, or the City Manager's designee, is authorized to review hardship cases and special cases within which strict application of the Chapter would result in serious hardship to a customer. A variance may be granted only for reasons involving health, safety, or economic hardship. Application for variance from requirements of the Chapter must be made on a form provided by the Director."

1. Identify the use of water for which a variance is being applied:_____

_____

_____

2. Above use is located at a (check one only): ____Residence ____Commercial Establishment

3. Identify the hardship for which a variance is requested.

_____

_____

_____

_____

VARIANCE APPLICATION
FROM
CITY OF TUCSON WATER DEPARTMENT
DROUGHT PREPAREDNESS PLAN
ORDINANCE NO. 10380 REQUIREMENTS
(Continued)

4. Cite specific health codes or safety regulations that impact your ability to comply with the Drought Preparedness and Response Plan Ordinance.

Applicant Signature:_____

Date:_____

OFFICE USE ONLY:

1. Reviewer_____
2. Date:_____
3. Status: Approve____Reject____

4. Comments:_____

COMMERCIAL OFFICE ONLY:

1.Reviewer:_____
2. Date Received:_____
3. Date Entered:_____

www.tucsonaz.gov/water