



Arizona Department
of Water Resources
September 2010

ARIZONA WATER ATLAS

VOLUME 1

EXECUTIVE SUMMARY



ACKNOWLEDGEMENTS

Director, Arizona Department of Water Resources
Herbert Guenther

Deputy Director, Arizona Department of Water Resources
Karen Smith

Assistant Director, Hydrology
Frank Corkhill

Assistant Director, Water Management
Sandra Fabritz-Whitney

Atlas Team
(Current and Former ADWR staff)
Linda Stitzer, Rich Burtell – Project Managers
Kelly Mott Lacroix - Asst. Project Manager
Phyllis Andrews
Carol Birks
Joe Stuart

Major Contributors
(Current and Former ADWR staff)
Tom Carr
John Fortune
Leslie Graser
William H. Remick
Saeid Tadayon-USGS

Other Contributors
(Current and Former ADWR staff)

Matt Beversdorf	Patrick Brand
Roberto Chavez	Jenna Gillis
Laura Grignano (Volume 8)	Sharon Morris
Pam Nagel (Volume 8)	Mark Preszler
Kenneth Seasholes (Volume 8)	Jeff Tannler (Volume 8)
Larri Tearman	Dianne Yunker

Climate
Gregg Garfin - CLIMAS, University of Arizona
Ben Crawford - CLIMAS, University of Arizona
Casey Thornbrugh - CLIMAS, University of Arizona
Michael Crimmins – Department of Soil, Water and Environmental
Science, University of Arizona

The Atlas is wide in scope and it is not possible to mention all those who helped at some time in its production, both inside and outside the Department. Our sincere thanks to those who willingly provided data and information, editorial review, production support and other help during this multi-year project.

CONTENTS

SECTION 1.0	
Atlas Purpose and Scope	1
SECTION 1.1	
Atlas Organization	1
SECTION 1.2	
Arizona Water Management and Planning Overview	2
SECTION 1.3	
Water Budgets	5
SECTION 1.4	
Water Resource Characteristics Summary	7
1.4.1 Geography	7
1.4.2 Hydrology	10
1.4.3 Climate	31
1.4.4 Environmental Conditions	37
1.4.5 Population	41
1.4.6 Water Supplies	50
1.4.7 Cultural Water Demand	57
1.4.8 Water Resource Issues	68
REFERENCES	74
ACRONYMS AND ABBREVIATIONS	83
DEFINITIONS	86
APPENDIX A: PLANNING AREA VOLUME CONTENT	94
APPENDIX B: DATA SOURCES AND METHODS	98
B.1 Adequate and Assured Water Supply Determinations	99
B.2 Aquifers	100
B.3 Climate	101
B.4 Contamination Sites	103
B.5 Cultural Water Demands	103
B.6 Drought	106
B.7 Effluent	106
B.8 Environmental Conditions	107
B.9 Geology	108
B.10 Land Ownership	108
B.11 Lands Survey	108
B.12 Physiographic Regions	109
B.13 Population	109
B.14 Recharge Facilities	109

B.15	Reservoirs	110
B.16	Rural Watershed Initiative Partnerships	111
B.17	Springs	111
B.18	Stockponds	112
B.19	Streams	112
B.20	Surface Water Rights	115
B.22	Water Quality	116
B.23	Wells	117
B.24	Water Issues	119
APPENDIX C: SUMMARY OF ARIZONA WATER LAW AND MANAGEMENT		122
C.1	Surface Water	123
C.2	Groundwater	124
C.3	Colorado River Water and the Central Arizona Project	127
C.4	Effluent	129
C.5	Underground Water Storage	129
C.6	Water Exchanges	129
C.7	Dams and Reservoirs	130
C.8	Arizona Drought and Conservation Programs	130
APPENDIX D: FEDERAL AGENCIES AND LAWS		136
D.1	Key Federal Agencies	137
D.2	Colorado River Management	138
D.3	Federal Reserved Rights	140
D.4	Summary of Key Federal Water Laws	140
APPENDIX E: ARIZONA CLIMATE AND DROUGHT		142
APPENDIX F: ARIZONA WATER PROTECTION FUND		148
APPENDIX G: INDIAN WATER RIGHTS CLAIMS AND SETTLEMENTS		162
G.1	Colorado River Entitlements	164
G.2	Congressionally Authorized Settlements	164
G.3	Current Settlement Negotiations	167
G.4	Unresolved Claims	168
APPENDIX H: SURFACE WATER RIGHT AND ADJUDICATION FILINGS		170
APPENDIX I: RURAL WATERSHED INITIATIVE		176

FIGURES

Figure 1-1	Arizona Planning Areas and Groundwater Basins	3
Figure 1-2	Schematic of a Water Budget	5
Figure 1-3	Surficial Geology and Physiographic Regions of Arizona	8
Figure 1-4	Measured Well Yields in Arizona	14
Figure 1-5	Generalized Cross-section of Water Bearing Formations in The Eastern Plateau Planning Area	15
Figure 1-6	Generalized Geologic Cross-Section for the Basin and Range Province	16
Figure 1-7	Generalized Hydrologic Cross-Section from the Mogollon Rim to the Town of Payson	17
Figure 1-8	Recent Depths to Groundwater in Arizona	18
Figure 1-9	Groundwater Level Changes in Arizona (1992-1995) to (2002-2005)	20
Figure 1-10	Arizona Watersheds, USGS Streamgages and Large Reservoirs	21
Figure 1-11	Major Streams and Reservoirs in Arizona	22
Figure 1-12	Perennial/Intermittent Streams and Major (>10 gpm) Springs in Arizona	25
Figure 1-13	May 1st Reservoir Storage on the Colorado, Gila and Salt/Verde Rivers on May 1st, 1980-2008	27
Figure 1-14	Arizona Meteorologic Stations and Average Precipitation and Temperature	32
Figure 1-15	Average Monthly Precipitation and Temperature by Planning Area, 1971-2000	34
Figure 1-16	Arizona winter (November-April) precipitation departures from average reconstructed from tree rings (1000-1988)	35
Figure 1-17	Average Water-Year Temperature and Total Precipitation by Planning Area, 1930-2002 (excludes the AMAs)	36
Figure 1-18	Arizona Biotic Communities and Ecoregions	38
Figure 1-19	Instream Flow Claims, Riparian Areas and Arizona Water Protection Fund Grant Locations	39
Figure 1-20	Arizona Population 1970-2009	41
Figure 1-21	High Growth Rate Communities (2000-2009)	44
Figure 1-22	Assured and Adequate Water Supply Determinations and Designations in Arizona	49
Figure 1-23	Average Annual Water Supplies Utilized in Arizona, 2001-2005 (in AF and % of total)	50
Figure 1-24	Registered Wells and Surface Water Diversion Points in Arizona	54
Figure 1-25	ADWR Index and Automated Wells in 2008	56
Figure 1-27	Contamination Sites in Arizona	59
Figure 1-28	Comparison of Arizona's Average Annual Water Demand to its Population, 1971-2005	60
Figure 1-29	Change in Average Annual Water Demand in Arizona Planning Areas	61

Figure 1-30	Average Annual Planning Area Water Demand by Sector and Water Source During 2001-2005	62
Figure 1-31	Cultural Water Demand Centers in Arizona	64
Figure 1-32	Average Annual Water Demand in Arizona by Sector, 2001-2005 (in AF and percentage of total)	65
Figure 1-33	Average Annual Agricultural Water Demand for Selected Planning Areas	66
Figure E-1	Average water-year (October-September) temperature (left) and total water-year precipitation in Arizona from 1930-2002	145
Figure E-2	Planning area water-year (October-September) precipitation departures from average for the 1942-1957 drought period	146
Figure F-1	Arizona Water Protection Fund Grant Locations	161
Figure H-1	General Stream Adjudications in Arizona	174
Figure I-1	Rural Watershed Initiative Participants	190

TABLES

Table 1-1	Typical components of a water budget	6
Table 1-2	Land ownership in Arizona	10
Table 1-3	Generalized Basin Hydrogeology	11
Table 1-4	Summary of basin groundwater data	12
Table 1-5	Flow characteristics of major Arizona streams	24
Table 1-6	Planning area and basin historic and projected population	42
Table 1-7	High growth communities in Arizona	43
Table 1-8	Adequacy determinations outside of the AMAs	45
Table 1-9	Assured water supply applications in the AMAs	46
Table 1-10	Designated water providers in Arizona as of May 2010	46
Table 1-11	Arizona v. California Decree accounting of the consumptive use of Colorado River water in Arizona (in acre-feet/year)	51
Table 1-12	Count of surface water right and adjudication filings by planning area	53
Table 1-13	Annual effluent generation and use by planning area (c. 2006)	57
Table 1-14	Average annual cultural water demand (2001-2005) ¹	63
Table 1-15	Average annual planning area industrial demand by category	67
Table 1-16	Average annual water demand on Arizona Indian Reservations (2001-2005)	68
Table 1-17	Percent of 2004 survey respondents reporting issue was a moderate or major concern	71
Table E-1	Arizona mean, high capacity and low capacity reservoir levels from 1971 through 2005, expressed in percent of total reservoir capacity (design flood pool)	144
Table F-1	AWPF Funded Projects through FY 2008 by Planning Area	150
Table H-1	Count of Surface Water Right and Adjudication Filings by Planning Area	175

