



1 **TECHNICAL MEMORANDUM**

2 **TO:** Bruce Buel, General Manager  
3 Nipomo Community Services District  
4 **FROM:** Alex Pappas, Joel Degner, Drew Beckwith, Brad Newton, Ph.D., P.G.  
5 (SAIC)  
6 **RE:** Emergency Water Shortage Regulations and Future Groundwater in Storage  
7 **DATE:** January 06, 2008

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8 **INTRODUCTION**

9 This technical memorandum presents an evaluation of Nipomo Community Services  
10 District's (NCSD) Draft Ordinance Chapter 3.24 - Emergency Water Shortage Regulations and  
11 an estimation of future groundwater in storage above mean sea level (GWS). This work was  
12 conducted under the General Consultation Task Order 100-06. This evaluation has evolved  
13 with the knowledge gleaned from interim work product prepared over the past months,  
14 summarized in five (5) technical memoranda titled: (1) Evaluation of Chapter 3.24 Emergency  
15 Water Shortages Regulations, dated June 6, 2007; (2) Alternative Methodology to Determine the  
16 Water Conservation Shortages Stages, dated August 28, 2007; (3) Evaluation of Groundwater in  
17 Storage for Triggering Conservation Stages, dated October 3, 2007; (4) Predicted Groundwater  
18 in Storage from Year 2007 through year 2039, dated November 21, 2007; and (5) Predicted  
19 Groundwater in Storage from Year 2007 through Year 2039, dated December 7, 2007.

20 Annual GWS within the Phase III boundary was computed from groundwater surface  
21 elevation measurements from 1975 to 2007, and was estimated for Year 2008 through Year 2039  
22 based on consumptive use of groundwater and a repetition of 1975 to 2007 hydrologic  
23 conditions. Year 2007 consumptive use was estimated from a land use classification of the one-  
24 foot resolution aerial photograph taken in June 2007. Estimates of future annual GWS were  
25 based on four (4) escalation scenarios applied to the Year 2007 annual consumptive use and four  
26 (4) alternative hydrologic conditions. The efficacy of the proposed Ordinance was tested  
27 against combinations of the four (4) scenarios of water demands and water shortage conditions.  
28

29 **SUMMARY OF FINDINGS**

30 GWS amounts that designate Water Shortage Conservation Stages I - IV were developed  
31 on the basis of historical GWS estimates, the change in GWS annually, and the magnitude of  
32 uncertainty in the estimates of GWS. The following GWS ranges are recommended to designate  
33 Stages I - IV of the Water Shortage Conservation Stages (all GWS values are reported in acre-  
34 feet [AF]):

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To: Bruce Buel  
 Re: Emergency Water Shortage Regulations  
 Date: January 06, 2008  
 Page: 2 of 15

1                   **Stage I Conservation - Water Watch**

2                                   Water Shortage Condition:  $100,000 > GWS \geq 90,000$

3                   **Stage II Conservation - Water Warning**

4                                   Water Shortage Condition:  $90,000 > GWS \geq 80,000$

5                   **Stage III Conservation - Water Emergency**

6                                   Water Shortage Condition:  $80,000 > GWS \geq 70,000$

7                   **Stage IV Conservation - Extreme Water Emergency**

8                                   Water Shortage Condition:  $GWS < 70,000$

9  
 10   **RESULTS**

11           The efficacy of the proposed Ordinance criteria presented in the Summary of Findings  
 12   were tested by applying them to historical GWS and to the estimated future GWS. Insights on  
 13   the effects of the ordinance relative to the timing and magnitude of potential water shortages as  
 14   well as the amounts of supplemental water requirement needed to provide a long-term water  
 15   supply to the communities of the Nipomo Mesa were gleaned from the future GWS estimates.

16  
 17   **Historical GWS (1975 - 2007)**

18           The Water Shortage Conservation Stages criteria were applied to the historical estimates  
 19   of GWS for the period 1975-2007 to demonstrate the effectiveness of using the proposed GWS  
 20   ranges in designating conservation stages. Increasing levels of conservation would have been  
 21   imposed in both of the declining GWS periods in the late 70s and late 80s (Figure 1). The effect  
 22   of conservation on the amount of GWS was not estimated in this analysis. However, making a  
 23   correction based on conservation goals proposed in the Ordinance would be expected to  
 24   decrease the rate of depletion of GWS thereby increasing GWS as compared to the observed  
 25   record. The following table summarizes the number of years each proposed Conservation Stage  
 26   would have been in effect during the historical period:

Stage	Criteria - GWS (AF)	Conservation Goal	Number of Years
None		0%	7
1	$100,000 > GWS \geq 90,000$	0%	8
2	$90,000 > GWS \geq 80,000$	10%	6
3	$80,000 > GWS \geq 70,000$	35%	4
4	$70,000 > GWS$	50%	6
<b>Total</b>			<b>31</b>

27  
 28   Note: Insufficient data exist in 1984 and 1997 to estimate the groundwater in storage.

To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 3 of 15

1 The number of years that the historical GWS estimate occur in 10,000 AF increments was  
2 plotted to evaluate the Conservation Stages criteria within the total range of GWS observed  
3 (Figure 2). GWS estimates are above 90,000 AF in fifteen years and there are 16 years when  
4 estimates are below 90,000 AF. The proposed conservation measures and goals would have  
5 been expected to affectively change the historical amount of GWS for one-half of the observed  
6 record; the 16 years when estimates below 90,000 AF.

### 7 8 **Future GWS (2008 - 2039)**

9 The Water Shortage Conservation Stages criteria were applied to the future estimates of  
10 GWS to demonstrate the effectiveness of the proposed GWS ranges in designating conservation  
11 stages. Sixteen (16) possible future GWS estimates from Year 2008 through Year 2039 were  
12 prepared by the consideration of four (4) scenarios of future consumptive use (CU) and four (4)  
13 potential hydrologic conditions.

14 Year 2007 total CU is approximately 10,650 acre feet per year (AFY), based on the land  
15 use classification and using a one-foot resolution aerial photograph. Four (4) scenarios of CU  
16 were prepared by assuming fixed annual escalation rates as follows:

Scenario	Annual Escalation Rate
S1	0%
S2	1%
S3	2.3%
S4	4%

17  
18 The four scenarios (S1 - S4) were evaluated under four hydrologic conditions as follows:  
19 1) a repetition of historical hydrologic condition (Year 1975 to Year 2007); 2) a repetition of  
20 historical hydrologic conditions with a 50% reduction of urban water consumptive use; 3) a dry  
21 hydrologic condition; and 4) a wet hydrologic condition. In general, each of the hydrologic  
22 conditions is described as follows. A repetition of historical hydrologic conditions begins the  
23 sequence with declining GWS periods in the late 70s and late 80s. Reduction of the CU by 50%  
24 is equivalent to reducing the groundwater extractions over the entire historical hydrologic  
25 condition. Dry and wet hydrologic conditions are defined by segmenting the historical record  
26 into wet periods and dry periods, holding the annual sequence within each period constant, and  
27 varying the order of wet and dry periods. Specifically, the historical record describes a dry  
28 period from Year 1975 to Year 1977 (D1), a wet period from Year 1977 to Year 1982 (W1), a dry  
29 period from Year 1985 to Year 1992 (D2), and a wet period from Year 1994 to Year 2001 (W2).  
30 Two hypothetical hydrologic conditions are presented as follows: DRY) a dry climate defined as  
31 D2 followed by D1 followed by W1 followed by W2, and WET) a wet climate defined as W2  
32 followed by W1 followed by D1 followed by D2.

To: Bruce Buel  
 Re: Emergency Water Shortage Regulations  
 Date: January 06, 2008  
 Page: 4 of 15

Calendar Year Order	
DRY	YR1985 - YR1992, YR1975 - YR1977, YR1977 - YR1982, YR1994 - YR2001
WET	YR1994 - YR2001, YR1977 - YR1982, YR1975 - YR1977, YR1985 - YR1992

These two hypothetical hydrologic conditions are 21 years long; and are shorter than the previous analyses of 32 years, however, 21 years of prediction are sufficient to understand the impact of dry conditions and wet conditions on GWS.

The Water Shortage Conservation Stages criteria were applied to all sixteen (16) possible future GWS estimates (Figure 3 through Figure 18). In general, Water Shortage Conservation Stage IV would be in effect by Year 2009, except for the Wet hydrologic condition where Stage IV is designated in Year 2021. In all future GWS estimates, with the exception of the wet hydrologic condition, all GWS is depleted by Year 2021 (14 years from the present), and may be as soon as Year 2015 (Dry hydrologic condition). The following table summarizes results from the four scenarios and four conditions:

32 year analysis						
Scenario	Consumptive Use (AFY)	Annual Escalation Rate	Year of Conservation Stage IV	Number of Years Until GWS is Depleted	Total Groundwater Depletion (AF)	Supplemental Water Requirement (AFY)
S1	10,650	0%	2008	12	152,230	4,760
S2		1%	2008	12	214,710	6,710
S3		2.3%	2008	12	318,390	9,950
S4		4%	2008	11	505,930	15,810
S1 w/conservation	8,360	0%	2009	14	78,950	2,470
S2 w/conservation		1%	2009	14	128,000	4,000
S3 w/conservation		2.3%	2009	14	209,410	6,540
S4 w/conservation		4%	2009	12	356,570	11,140
21 year analysis						
S1 Dry	10,650	0%	2009	8	71,680	3,410
S2 Dry		1%	2009	8	97,990	4,670
S3 Dry		2.3%	2009	8	137,970	6,570
S4 Dry		4%	2009	8	202,140	9,630
S1 Wet	10,650	0%	2023	> 22	71,680	3,410
S2 Wet		1%	2023	21	97,990	4,670
S3 Wet		2.3%	2022	18	137,970	6,570
S4 Wet		4%	2021	16	202,140	9,630

### Implications of Water Shortages

The long-term (Year 1975 - Year 2000) average recharge from rainfall to the GWS is 5,430 AFY (SAIC Phase III Hydrologic Inventory, Oct 2002). Year 2007 CU (10,650 AFY) exceeds long-term average recharge from rainfall by 5,220 AFY. An average annual groundwater supply shortfall of 5,220 AFY accumulated each year will deplete the current GWS of 93,000 AF in 18 years. From these long-term averages, and without considering the inter-annual variability of hydrology, 5,220 AF of supplemental water is required annually to maintain the current 93,000 AF of GWS.

To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 5 of 15

1 ***Repeat Historical Hydrologic Conditions***

2 Predicted GWS from Year 2007 to Year 2039 is based on CU scenarios (S1, S2, S3, and S4)  
3 and a repetition of historical hydrologic conditions (Year 1975 to Year 2007). In Year 2039, the  
4 total S1 GWS is depleted by 152,230 AF (sum of Column I, Table 1), and the GWS is zero in 12  
5 years (Year 2019, blue line crosses zero abscissa, Figure 19). Augmenting CU by escalation rates  
6 of 1.0%, 2.3%, and 4.0% increases the total depletion of GWS and decreases the amount of time  
7 before GWS is zero. The total S2 (1.0% escalation) GWS depletion is 214,710 AF (sum of  
8 Column M, Table 1), the total S3 (2.3% escalation) GWS depletion is 318,390 AF (sum of Column  
9 Q, Table 1), and the total S4 (4.0% escalation) GWS depletion is 505,930 AF (sum of Column U,  
10 Table 1) over the 32 year prediction period, respectively. GWS is fully depleted by Year 2019  
11 under all scenarios (all predictions cross zero abscissa, Figure 19). On average, a minimum of  
12 4,800 AFY of supplemental water is required to meet current consumptive use demand, and  
13 depending on growth, the amount may be as high as 16,000 AFY, as determined from this  
14 simplified analysis.

15

16 ***50% Reduction in Urban Water Consumptive Use Condition***

17 A 50% reduction in urban water consumptive use may be garnered by imposing a Stage  
18 IV Conservation Measure. This would reduce Year 2007 total CU to 8,360 AFY (Column G,  
19 Table 2), 2,290 AFY less than the estimated Year 2007 CU. Estimated CU with conservation  
20 exceeds long-term average recharge to the GWS from rainfall by 2,930 AFY, and GWS is fully  
21 depleted by Year 2021 under all scenarios (all predictions cross zero abscissa, Figure 20). It is  
22 important to note that in S1 w/ conservation, GWS dips only slightly below sea level in Year  
23 2021, and rebounds above sea level within six years (by Year 2027). This analysis suggests that  
24 urban conservation alone will not be sufficient to maintain the GWS.

25 With conservation, the amount of supplemental water required to meet CU ranges from  
26 approximately 2,500 AFY to 11,000 AFY. The reduction in urban water CU by imposing Stage  
27 IV Conservation Measures will extend the time until GWS is below sea level, but only by one to  
28 two years. Notably, the historical hydrologic condition ends in a drying trend; if this drying  
29 trend was followed by a series of wet years, it is possible that GWS would remain above sea  
30 level for the 0% escalation rate scenario.

31

32 ***Dry and Wet Conditions***

33 A 21-year dry hydrologic condition is analyzed by altering the order of the historical  
34 record. Using a 2007 CU estimate of 10,650 AF (Column G, Table 3), GWS is fully depleted by  
35 2015 under all scenarios of the dry hydrologic condition (all predictions cross zero abscissa,  
36 Figure 21).

To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 6 of 15

1 Similarly, a 21-year wet hydrologic condition is analyzed by altering the order of the  
2 historical record. Using a 2007 CU estimate of 10,650 AF (Column G, Table 4), GWS is not  
3 depleted under a 0% annual escalation of CU during the 21 year cycle; however, it trends  
4 significantly downward. GWS is fully depleted by 2029 for S2 Wet, is depleted by 2026 for S3  
5 Wet, and is depleted by 2024 for S4 Wet (predictions cross zero abscissa, Figure 22). This  
6 analysis suggests that even when presented with unusually wet hydrologic conditions, the  
7 water resources available to Nipomo Mesa are at risk within 15 years given the current balance  
8 between water supply and demand.

9 The amount of supplemental water required to meet CU during dry and wet conditions is  
10 not directly comparable to the previous conditions because the length of the analyses differ.  
11 However, an adjustment to the previous conditions can be achieved by computing the average  
12 supplemental water required for the first 21 years. The recalculated supplemental water  
13 requirement for the historical hydrologic conditions ranges from 6,700 AFY to 13,000 AFY; and  
14 for the 50% reduction in urban water CU condition it ranges from 4,500 AFY to 9,300 AFY. The  
15 amount of supplemental water required for both the dry and wet conditions ranges from 3,400  
16 AFY to 9,600 AFY. On average, no difference exists between dry and wet conditions because  
17 one is simply a re-ordering of the other, and the total amounts are the same.

#### 18 19 **Year 2007 Consumptive Use Estimate**

20 Year 2007 CU is based on the land use classification, and is approximately 10,650 acre  
21 feet per year (AFY). Land use within the Phase III boundary of the Nipomo Mesa area was  
22 classified from a one-foot resolution aerial photograph dated June 2007 (Figure 23).

#### 23 24 **METHODOLOGY**

25 Analyses presented herein began with the estimation of Year 2007 CU within the Phase III  
26 boundary of the Nipomo Mesa Management Area. Estimates of future CU, based on various  
27 possible scenarios of escalation, were combined with four possible hydrologic conditions to  
28 estimate annual GWS to Year 2039. The data produced through this analysis and the data  
29 available from the historical record were used to derive the criteria for determining Water  
30 Shortage Conservation Stages I - IV. Presented below is a detailed description of the  
31 methodologies used in these evaluations.

#### 32 33 **BASES FOR ANALYSES**

34 The bases for the analyses are listed following:  
35

To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 7 of 15

- 1           1. Urban land coverage was digitized following the 1996 DWR methodology. All  
2           land which contains residential units, multi-family housing, rural homesites,  
3           industry, and commercial space was classified as urban land and given the same  
4           urban water demand factor.
- 5           2. The urban applied demand factor (0.63 AF/acre) is the same in Year 2007 as it was  
6           in Year 2000.
- 7           3. The agricultural land use classification in Year 2007 has the same ratio of crop  
8           types detailed in the Year 1996 DWR survey.
- 9           4. The golf course consumptive use factor is the same in Year 2007 as in Year 2000.
- 10          5. The impact of the change in land use from native to agriculture or urban in the  
11          amount of future rainfall that recharges GWS is not accounted for in this analysis.  
12          Conversion from native to other uses had an effect as was shown in testimony for  
13          the adjudication but is not considered in this evaluation for simplicity.
- 14          6. Subsurface inflow to the GWS is equal to the subsurface outflow. Variations in  
15          subsurface flow as a function of the change in groundwater surface elevation are  
16          not considered in the GWS calculations.
- 17          7. Agricultural and Golf Course CU depend on precipitation. In wet years,  
18          agricultural lands and golf courses require less irrigation, and in dry years  
19          agricultural lands require more irrigation. In 2007, the precipitation was 6.92  
20          inches, the driest year on record. The estimate of agricultural and golf course CU  
21          in 2007 is therefore higher than it would be in a year with average precipitation.

22

### 23   **Estimation of 2007 Consumptive Use**

24           Year 2007 CU was estimated from the land use classification and using a June 2007 one-  
25           foot resolution aerial photograph. The following sections provide a detailed description of 1)  
26           the classification of the aerial photography used to estimate land use, and 2) the conversion of  
27           land use estimates to CU factors for urban, agriculture, and golf course.

28

### 29   ***2007 Aerial Photo Land Use Classification***

30           Land use was classified into 4 main categories based on the methodology used by DWR in  
31           1996 (DWR, 2000); agriculture, urban, golf course and native vegetation (undeveloped lands).  
32           The classification activity was conducted with the ArcGIS software package and stored as  
33           shapefiles.

34

To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 8 of 15

1 Agricultural Land

2 Agricultural land was classified into five categories, easily identifiable from the aerial  
3 photography; orchard, fallow, row crop, semi-ag, and pasture. Past methodology incorporated  
4 by the DWR included field visits to verify the agricultural classifications, but this level of effort  
5 was outside the scope of this investigation. To estimate land use to the same level of resolution  
6 employed by the 1996 DWR classification, the ratio of each agricultural land use type relative to  
7 the total agricultural land use was identified for the 1996 DWR survey. These ratios were then  
8 imposed on SAIC's 2007 agricultural land use classification and agricultural acreages were  
9 linearly interpolated between years when data were collected (1996 to 2007).

10

11 Urban Land

12 Urban land was classified following the 1996 DWR methodology. All land which contains  
13 residential units, multi-family housing, rural homesites, industry, and commercial space was  
14 classified as urban land. Annual urban acreages were linearly interpolated between years when  
15 data were collected.

16

17 Golf Course

18 Golf courses were classified separately from Agricultural or Urban Lands. The acreage of  
19 Black Lake and Cypress Ridge Golf Courses previously estimated for the Phase III Trial  
20 Hydrologic Inventory was used to represent these entities. The Woodlands Golf Course, not  
21 estimated in the Phase III trial, was determined by interpreting the 2007 aerial photograph.

22

23 Native

24 Native vegetation was classified following the 1996 DWR methodology. In the DWR  
25 methodology all undeveloped land was classified as native vegetation and includes groves of  
26 non-native eucalyptus and fields of non-native grasses.

27

Total land use coverage for the four main categories is summarized below:

LAND USE	2007 Area (Acres)
AGRICULTURE	2,590
URBAN	9,670
GOLF COURSE	630
NATIVE	6,520
<b>TOTAL</b>	<b>19,410</b>



To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 9 of 15

1

2 *Consumptive Use Calculations for each Land Use Class*

3 Following the classification of land use within the Phase III boundary, consumptive use  
4 was calculated based on the acreage of each specific land use as described below.

5

6 Agricultural Consumptive Use

7 Agricultural consumptive use was based on the crop specific evapotranspiration rate of  
8 applied water (ET<sub>AW</sub>). The ET<sub>AW</sub> for an agricultural crop is equal to the seasonal crop  
9 evapotranspiration (ET<sub>c</sub>) less the effective precipitation.

10 
$$ET_{AW} = ET_c - \text{Effective Precipitation}$$

11 Simply stated, the volume of groundwater delivered and consumed by a crop is the amount of  
12 demand not met by rainfall.

13 For each year in the hydrologic inventory, a lookup table was used to select the ET<sub>AW</sub> for a  
14 crop based on the annual precipitation. Effective precipitation was estimated as the difference  
15 between assumed constant ET<sub>c</sub> and assigned ET<sub>AW</sub> for each year.

16 ET<sub>c</sub> and ET<sub>AW</sub> values for vegetative crops in a coastal climate like that of the Nipomo Mesa  
17 were found in Tables 14 and 15 of the DWR report "Vegetative Water Use in California,"  
18 Bulletin 113-3, dated April 1975. The representative ET<sub>AW</sub> value for each crop type was adjusted  
19 based on the average annual precipitation and the ET<sub>c</sub> value was held constant for all years. ET<sub>c</sub>  
20 and ET<sub>AW</sub> values were obtained using Tables 14 and 15 for the general agricultural crop classes  
21 of grain, pasture, truck and deciduous. Since these tables do not contain representative values  
22 of ET<sub>c</sub> and ET<sub>AW</sub> for the general agricultural crop class of citrus and subtropical, values from  
23 Table 21 of the 1975 DWR Bulletin 113-3 were used.

24 ET<sub>c</sub> Values Assigned to Land Use Codes:

Land Use Class Code	ET <sub>c</sub> (AF/acre)
Citrus and Subtropical	2.5
Deciduous	2.4
Grain	1.3
Field Crops, Truck, Nursery and Berry	1.2
Pasture	2.8
Grain Multi Crop	2.2
Field Crops Multi Crop	2.4
Semi Agricultural	1.0
Idle, Un-Irrigated and Fallow Agriculture	0.5

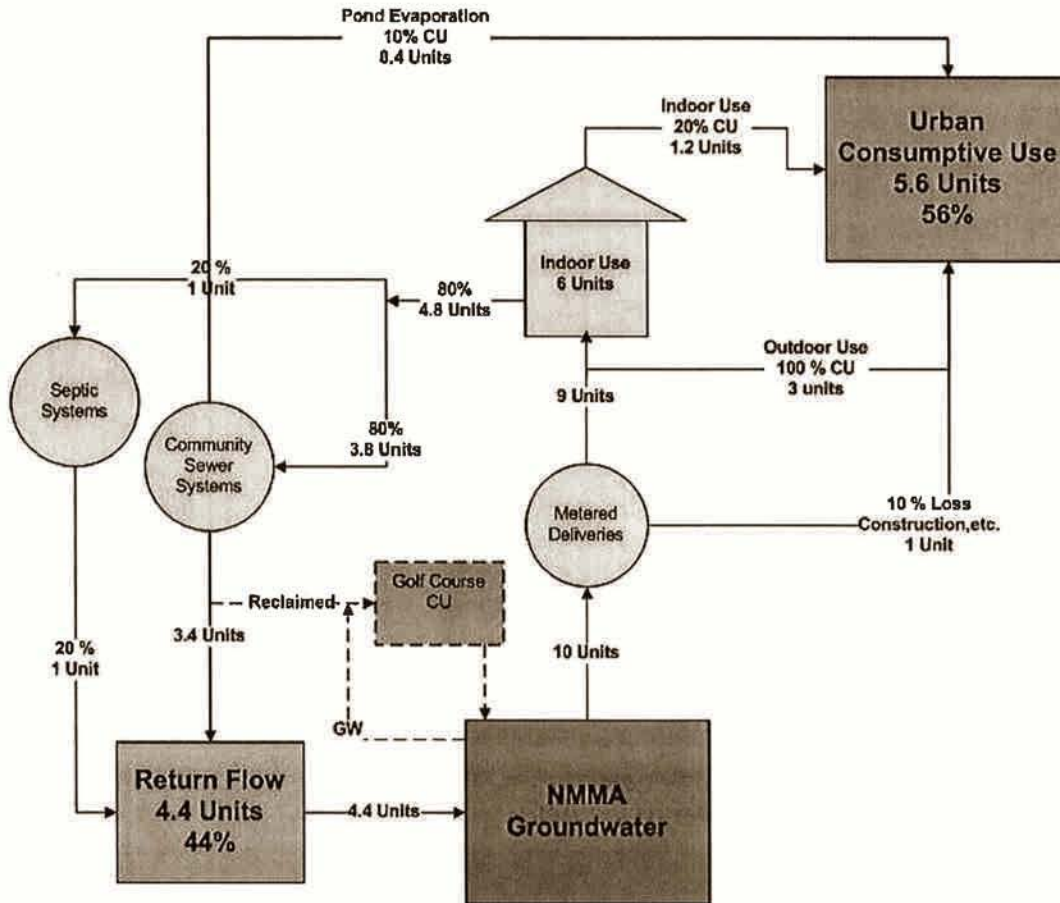
25

To: Bruce Buel  
 Re: Emergency Water Shortage Regulations  
 Date: January 06, 2008  
 Page: 10 of 15

1 Urban Water Consumptive Use

2 The schematic below details how urban CU, calculated as 56 percent of the urban applied  
 3 water demands based on a return flow of 44 percent, was determined.

4 **Estimated Returns and Depletions for Urban Applied Water Demands:**



5  
 6  
 7  
 8  
 9  
 10

The urban applied water demands were calculated by multiplying the estimated urban acreage in the Phase III boundary by the unit production of 0.63 acre-feet per acre. The unit production is a weighted average based on Nipomo Mesa water purveyors' 2000 groundwater production within the Phase III boundary (See table below).

To: Bruce Buel  
 Re: Emergency Water Shortage Regulations  
 Date: January 06, 2008  
 Page: 11 of 15

Urban Use	Approximate Area in Year 2000 (Acres)	Production in Year 2000 (AF)	Unit Production (AF/Acre)
NCSD	3,506	1,830	0.52
Cal Cities Water	1,332	1,300	0.98
Rural Water Co.	855	500	0.58
Other Urban	407	189	0.46
<b>Total Area =</b>	<b>6,100</b>	<b>Weighted Avg Unit Production (AF/A) =</b>	<b>0.63</b>

This unit production factor does not include the Conoco-Phillips refinery water demands or the rural home sites within the Phase III boundary. The Conoco-Phillips refinery land use was placed in its own urban industrial category and its production was estimated to be 1,370 AF/year. There are no return flows from Conoco-Phillips' groundwater production.

Reclaimed water consumed by golf courses was accounted for by assigning a separate land use category for golf course grasses. Since all supply water to the golf course land use originates from local groundwater, the net change did not affect the urban water use schematic and the urban returns estimated for the hydrologic inventory.

Golf Course Consumptive Use

The golf course annual CU was estimated using a weighted annual crop evapotranspiration (ET<sub>c</sub>) of 2.3 acre-feet per acre (AF/acre) that represents fairway, green, rough and fringe areas, and was based on the 1994 report "Water Resources Management Study for Cypress Ridge" by Cleath and Associates.

The golf course ET<sub>c</sub> is met by precipitation and irrigation. Effective precipitation, the estimated amount of rainfall that meets part of the ET<sub>c</sub>, is 40%, based on Cleath and Associates 1994 report. Therefore, the evapotranspiration of applied water by the golf course (ET<sub>AW</sub>) is equal to the annual CU of the golf course grasses less the effective precipitation.

$$\text{Evapotranspiration of Applied Water (ET}_{AW}) = \text{ET}_{c} - (40\% * \text{Annual Precipitation})$$

To estimate the total golf course CU of groundwater, the ET<sub>AW</sub> was multiplied by the total irrigated golf course acreage within the Phase III boundary. There are three golf courses on the Nipomo Mesa: Cypress Ridge, Black Lake, and Woodlands golf courses. All these golf courses meet some of their irrigation demands with recycled water.

**Future Consumptive Use and Groundwater in Storage Above Sea Level**

Year 2007 CU was used as the basis for estimating future GWS. Four scenarios of future CU were defined by annual escalation rates of 0%, 1.0%, 2.3%, and 4.0% beginning in 2008.

To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 12 of 15

1 Future CU scenarios were evaluated in combination with four hydrologic conditions to develop  
2 estimates of and a broad understanding of future GWS.

3

#### 4 ***General Concept***

5 The annual change in GWS is a function of the volume of precipitation which percolates to  
6 groundwater during a year minus the volume of groundwater which is consumed in that year.  
7 For this analysis, future GWS was estimated as the previous year's GWS plus the predicted  
8 change in storage. The change in storage is equivalent to the balance between percolation and  
9 consumption. The following sections present a detailed description of the methods used to  
10 quantify this approach.

11

#### 12 ***Predicted Groundwater in Storage Above Sea Level with Historical*** 13 ***Hydrologic Conditions***

14 Table 1 presents the results of the future GWS based on a repeat of historical hydrology  
15 from Year 1975 to 2007. In this analysis, future consumptive use is defined as the product of  
16 Year 2007 consumptive use and the annual escalation rate, as follows:

17

18 
$$\text{Future Consumptive Use} = 2007 \text{ consumptive use} * (1 + \text{escalation rate})^{\text{index}}.$$

19 Where the index is equal to the future year of interest (i.e. for 2008 the index = 1)

20

21 The change in GWS from Year 1975 to Year 1976 ( $\Delta GWS_{1976,1975}$ ) and the change in the  
22 consumptive use from Year 1976 to Year 2008 ( $\Delta CU_{1976,2008}$ ) was computed and summed. This  
23 sum was added to the Year 2007 GWS to predict the Year 2008 GWS (Table 1), as follows:

24

25 
$$2008 \text{ GWS} = 2007 \text{ GWS} + (\Delta GWS_{1976,1975} + \Delta CU_{1976,2008}).$$

26

27 This calculation was repeated for each year to Year 2039. The section below describes the  
28 content of each column in Table 1 used to compute estimates of future GWS.

29

#### 30 **Detailed description of Table 1**

31 *Column A - Index Year*

32 *Column B - Historical Year of Interest*

33 *Column C - Estimated total GWS (SAIC 2007, technical memorandum on GWS)*

34 *Column D - Change in storage*

To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 13 of 15

1 This value is the current year's total GWS minus the previous year's total GWS.

2 *Column E - Consumptive Use*

3 This value is based on estimates from previously discussed methodology.

4 *Column F - Year*

5 This column represents the future year of interest for estimated future values.

6 *Column G - Predicted CU based on a 0% annual escalation rate.*

7 This value is the equivalent of the estimated CU for the Year 2007 repeated until the  
8 Year 2039 (index 32). The following equation was used to generate the values in this  
9 column:

$$\text{Future consumptive use (column G)} = 2007 \text{ CU} * (1 + \text{escalation rate})^{(\text{column A})}$$

10 *Column H - Change in CU*

11 This value is the estimated future CU for a given year (Column G) minus the  
12 historical CU (Column E).

13 *Column I - Change in Storage (predicted)*

14 The change in storage (predicted) has been calculated as the historical change in  
15 storage (Column D) minus the predicted change in CU (Column H).

16 This creates an estimate of predicted change in storage accounting for historical  
17 precipitation.

18 *Column J - Cumulative Storage*

19 This column calculates the total GWS for a given future year. It takes the volume of  
20 GWS of the previous year and adds to it the current year's change in storage  
21 (Column I).

22

23 The methodology used to arrive at Column J is repeated when changing the CU annual  
24 escalation rate. Calculations using the 1.0% escalation rate are presented in Columns K through  
25 N, using the 2.3% escalation rate in Columns O through R, and using the 4.0% escalation rate in  
26 Columns S through V.

27

28 ***Future Groundwater in Storage Above Sea Level with 50% Urban***

29 ***Conservation (Table 2)***

30 The purpose of this evaluation is to understand the impact of urban conservation on  
31 estimates of GWS. Urban conservation is represented as a 50% reduction in all urban water  
32 consumption by applying a Stage IV Conservation Measure. Annual GWS was estimated by  
33 the same procedure described for Table 1 with the value of CU based on 50% urban

To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 14 of 15

1 conservation (Table 2). The water demand for agriculture and for native vegetation was not  
2 reduced.

3

4 ***Predicted Groundwater in Storage Above Sea Level During Dry and Wet***  
5 ***Hydrologic Conditions (Table 3 and 4)***

6 The purpose of this evaluation is to understand the impact of climate variability on GWS.  
7 Synthetic hydrologic conditions were created by separating the historical climatic conditions  
8 into wet periods and dry periods. Specifically, the historical GWS (Column C, Table 1)  
9 describes a dry period from Year 1975 to Year 1977 (D1), a wet period from Year 1977 to Year  
10 1982 (W1), a dry period from Year 1985 to Year 1992 (D2), and a wet period from Year 1994 to  
11 Year 2001 (W2). The two alternative synthetic climate conditions were created: 1) a dry  
12 hydrology defined as D2 followed by D1 followed by W1 followed by W2, and 2) a wet  
13 hydrology defined as W2 followed by W1 followed by D1 followed by D2.

	Calendar Year Order
DRY	YR1986 - YR1992, YR1976 - YR1977, YR1978 - YR1982, YR1995 - YR2001
WET	YR1995 - YR2001, YR1978 - YR1982, YR1976 - YR1977, YR1986 - YR1992

14 These two synthetic hydrologic conditions are 21 years long, shorter than the previous analyses  
15 for 32 years. However, 21 years of prediction are sufficient to understand the impact of dry  
16 hydrologic and wet hydrologic conditions on GWS and future CU.

17 Annual GWS was estimated for the dry and wet hydrologic conditions by the same  
18 procedure described above for Table 1. Note the change in storage (Tables 3 and 4, Column C)  
19 follows with the reordering of calendar years to simulate a given hydrologic condition.

20

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To: Bruce Buel  
Re: Emergency Water Shortage Regulations  
Date: January 06, 2008  
Page: 15 of 15

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Predicted Groundwater in Storage Above Sea Level in Acre Feet  
HISTORICAL HYDROLOGIC CONDITIONS

Historic Data					Scenario 1					Scenario 2				Scenario 3				Scenario 4			
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Index	Year	Storage	Change in Storage	Consumptive Use	Year	Consumptive Use 0% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage	Consumptive Use 1% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage	Consumptive Use 2.3% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage	Consumptive Use 4% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage
		Oct. 3, 2007 Memo	[C] - [C(Prev)]	Hydro Inv updated 2007		2007 Consumptive Use	[G] - [E]	[D] - [H]	[J(Prev)] + [I]	$10,650 \times (1+0.01)^A$	[K] - [E]	[D] - [L]	[N(Prev)] + [M]	$10,650 \times (1+0.023)^A$	[O] - [E]	[D] - [P]	[R(Prev)] + [Q]	$10,650 \times (1+0.023)^A$	[S] - [E]	[D] - [T]	[V(Prev)] + [U]
0	1975	99,000		3,340	2007	10,650	7,310		93,000	10,650	7,310		93,000	10,650	7,310		93,000	10,650	7,310		93,000
1	1976	82,000	-17,000	3,480	2008	10,650	7,170	-24,170	68,830	10,760	7,280	-24,280	68,720	10,890	7,410	-24,410	68,590	11,080	7,600	-24,600	68,400
2	1977	64,000	-18,000	3,760	2009	10,650	6,890	-24,890	43,940	10,860	7,100	-25,100	43,620	11,150	7,390	-25,390	43,200	11,520	7,760	-25,760	42,640
3	1978	84,000	20,000	3,470	2010	10,650	7,180	12,820	56,760	10,970	7,500	12,500	56,120	11,400	7,930	12,070	55,270	11,980	8,510	11,490	54,130
4	1979	72,000	-12,000	3,800	2011	10,650	6,850	-18,850	37,910	11,080	7,280	-19,280	36,840	11,660	7,860	-19,860	35,410	12,460	8,660	-20,660	33,470
5	1980	88,000	16,000	3,920	2012	10,650	6,730	9,270	47,180	11,190	7,270	8,730	45,570	11,930	8,010	7,990	43,400	12,960	9,040	6,960	40,430
6	1981	97,000	9,000	4,050	2013	10,650	6,600	2,400	49,580	11,310	7,260	1,740	47,310	12,210	8,160	840	44,240	13,480	9,430	-430	40,000
7	1982	123,000	26,000	4,170	2014	10,650	6,480	19,520	69,100	11,420	7,250	18,750	66,060	12,490	8,320	17,680	61,920	14,010	9,840	16,160	56,160
8	1983	95,000	-28,000	4,110	2015	10,650	6,540	-34,540	34,560	11,530	7,420	-35,420	30,640	12,770	8,660	-36,660	25,260	14,580	10,470	-38,470	17,690
9	1984	N/A	5,500	4,570	2016	10,650	6,080	-580	33,980	11,650	7,080	-1,580	33,980	13,070	8,500	-3,000	22,260	15,160	10,590	-5,090	12,600
10	1985	106,000	5,500	4,640	2017	10,650	6,010	-510	33,470	11,760	7,120	-1,620	27,440	13,370	8,730	-3,230	19,030	15,760	11,120	-5,620	6,980
11	1986	98,000	-8,000	5,240	2018	10,650	5,410	-13,410	20,060	11,880	6,640	-14,640	12,800	13,680	8,440	-16,440	2,590	16,400	11,160	-19,160	-12,180
12	1987	83,000	-15,000	5,520	2019	10,650	5,130	-20,130	-70	12,000	6,480	-21,480	-8,680	13,990	8,470	-23,470	-20,880	17,050	11,530	-26,530	-38,710
13	1988	80,000	-3,000	5,640	2020	10,650	5,010	-8,010	-8,080	12,120	6,480	-9,480	-18,160	14,310	8,670	-11,670	-32,550	17,730	12,090	-15,090	-53,800
14	1989	59,000	-21,000	5,840	2021	10,650	4,810	-25,810	-33,890	12,240	6,400	-27,400	-45,560	14,640	8,800	-29,800	-62,350	18,440	12,600	-33,600	-87,400
15	1990	62,000	3,000	6,500	2022	10,650	4,150	-1,150	-35,040	12,360	5,860	-2,860	-48,420	14,980	8,480	-5,480	-67,830	19,180	12,680	-9,680	-97,080
16	1991	62,000	0	6,070	2023	10,650	4,580	-4,580	-39,620	12,490	6,420	-6,420	-54,840	15,320	9,250	-9,250	-77,080	19,950	13,880	-13,880	-110,960
17	1992	61,000	-1,000	6,070	2024	10,650	4,580	-5,580	-45,200	12,610	6,540	-7,540	-62,380	15,680	9,610	-10,610	-87,690	20,750	14,680	-15,680	-126,640
18	1993	72,000	11,000	5,980	2025	10,650	4,670	6,330	-38,870	12,740	6,760	4,240	-58,140	16,040	10,060	940	-86,750	21,570	15,590	-4,590	-131,230
19	1994	60,000	-12,000	6,110	2026	10,650	4,540	-16,540	-55,410	12,870	6,760	-18,760	-76,900	16,410	10,300	-22,300	-109,050	22,440	16,330	-28,330	-159,560
20	1995	87,000	27,000	5,860	2027	10,650	4,790	22,210	-33,200	13,000	7,140	19,860	-57,040	16,780	10,920	16,080	-92,970	23,340	17,480	9,520	-150,040
21	1996	76,000	-11,000	6,260	2028	10,650	4,390	-15,390	-48,590	13,120	6,860	-17,860	-74,900	17,170	10,910	-21,910	-114,880	24,270	18,010	-29,010	-179,050
22	1997	N/A	14,500	6,360	2029	10,650	4,290	10,210	-38,380	13,260	6,900	7,600	-67,300	17,560	11,200	3,300	-111,580	25,240	18,880	-4,380	-183,430
23	1998	105,000	14,500	6,640	2030	10,650	4,010	10,490	-27,890	13,390	6,750	7,750	-59,550	17,970	11,330	3,170	-108,410	26,250	19,610	-5,110	-188,540
24	1999	106,000	1,000	7,250	2031	10,650	3,400	-2,400	-30,290	13,520	6,270	-5,270	-64,820	18,380	11,130	-10,130	-118,540	27,300	20,050	-19,050	-207,590
25	2000	108,000	2,000	7,420	2032	10,650	3,230	-1,230	-31,520	13,660	6,240	-4,240	-69,060	18,800	11,380	-9,380	-127,920	28,390	20,970	-18,970	-226,560
26	2001	118,000	10,000	7,650	2033	10,650	3,000	7,000	-24,520	13,790	6,140	3,860	-65,200	19,240	11,590	-1,590	-129,510	29,530	21,880	-11,880	-238,440
27	2002	96,000	-22,000	8,380	2034	10,650	2,270	-24,270	-48,790	13,930	5,550	-27,550	-92,750	19,680	11,300	-33,300	-162,810	30,710	22,330	-44,330	-282,770
28	2003	94,000	-2,000	8,390	2035	10,650	2,260	-4,260	-53,050	14,070	5,680	-7,680	-100,430	20,130	11,740	-13,740	-176,550	31,940	23,550	-25,550	-308,320
29	2004	89,000	-5,000	8,660	2036	10,650	1,990	-6,990	-60,040	14,210	5,550	-10,550	-110,980	20,590	11,930	-16,930	-193,480	33,210	24,550	-29,550	-337,870
30	2005	98,000	9,000	8,730	2037	10,650	1,920	7,080	-52,960	14,350	5,620	3,380	-107,600	21,070	12,340	-3,340	-196,820	34,540	25,810	-16,810	-354,680
31	2006	107,000	9,000	9,380	2038	10,650	1,270	7,730	-45,230	14,500	5,120	3,880	-103,720	21,550	12,170	-3,170	-199,990	35,920	26,540	-17,540	-372,220
32	2007	93,000	-14,000	10,650	2039	10,650	0	-14,000	-59,230	14,640	3,990	-17,990	-121,710	22,050	11,400	-25,400	-225,390	37,360	26,710	-40,710	-412,930
Total			-6,000	197,910		351,450	153,540	-152,230		413,930	216,020	-214,710		517,610	319,700	-318,390		705,150	507,240	-505,930	
Average			-190	6,000		10,650	4,650	-4,760		12,540	6,550	-6,710		15,690	9,690	-9,950		21,370	15,370	-15,810	

Notes:

Due to lack of available data, the change in groundwater storage was averaged between known values and split equally to the unknown values.

N/A Data unavailable.

**bold** Indicates first year in which the groundwater in storage is below sea level.

All numbers have been rounded to the nearest 10.



**Predicted Groundwater in Storage Above Sea Level in Acre Feet  
50% REDUCTION OF URBAN WATER CONSUMPTIVE USE**

Historic Data					Scenario 1					Scenario 2				Scenario 3				Scenario 4			
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Index	Year	Storage	Change in Storage	Consumptive Use	Year	Consumptive Use 0% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage	Consumptive Use 1% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage	Consumptive Use 2.3% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage	Consumptive Use 4% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage
		Oct. 3, 2007 Memo	[C] - [C(prev)]	Hydro Inv updated 2007		2007 Consumptive Use	[G] - [E]	[D] - [H]	[J(prev)] + [I]	$10,650 \cdot (1+.01)^{[A]}$	[K] - [E]	[D] - [L]	[N(prev)] + [M]	$10,650 \cdot (1+.023)^{[A]}$	[O] - [E]	[D] - [P]	[R(prev)] + [Q]	$10,650 \cdot (1+.023)^{[A]}$	[S] - [E]	[D] - [T]	[V(prev)] + [U]
0	1975	99,000		3,340	2007	10,650	7,310		93,000	10,650	7,310		93,000	10,650	7,310		93,000	10,650	7,310		93,000
1	1976	82,000	-17,000	3,480	2008	8,360	4,880	-21,880	71,120	8,440	4,960	-21,960	71,040	8,550	5,070	-22,070	70,930	8,690	5,210	-22,210	70,790
2	1977	64,000	-18,000	3,760	2009	8,360	4,600	-22,600	48,520	8,530	4,770	-22,770	48,270	8,750	4,990	-22,990	47,940	9,040	5,280	-23,280	47,510
3	1978	84,000	20,000	3,470	2010	8,360	4,890	15,110	63,630	8,610	5,140	14,860	63,130	8,950	5,480	14,520	62,460	9,400	5,930	14,070	61,580
4	1979	72,000	-12,000	3,800	2011	8,360	4,560	-16,560	47,070	8,700	4,900	-16,900	46,230	9,160	5,360	-17,360	45,100	9,780	5,980	-17,980	43,600
5	1980	88,000	16,000	3,920	2012	8,360	4,440	11,560	58,630	8,790	4,870	11,130	57,360	9,370	5,450	10,550	55,650	10,170	6,250	9,750	53,350
6	1981	97,000	9,000	4,050	2013	8,360	4,310	4,690	63,320	8,870	4,820	4,180	61,540	9,580	5,530	3,470	59,120	10,580	6,530	2,470	55,820
7	1982	123,000	26,000	4,170	2014	8,360	4,190	21,810	85,130	8,960	4,790	21,210	82,750	9,800	5,630	20,370	79,490	11,000	6,830	19,170	74,990
8	1983	95,000	-28,000	4,110	2015	8,360	4,250	-32,250	52,880	9,050	4,940	-32,940	49,810	10,030	5,920	-33,920	45,570	11,440	7,330	-35,330	39,660
9	1984	N/A	5,500	4,570	2016	8,360	N/A	3,790	54,590	9,140	4,570	930	50,740	10,260	5,690	-190	45,380	11,900	7,330	-1,830	37,830
10	1985	106,000	5,500	4,640	2017	8,360	3,720	1,780	56,370	9,230	4,590	910	51,650	10,490	5,850	-350	45,030	12,370	7,730	-2,230	35,600
11	1986	98,000	-8,000	5,240	2018	8,360	3,120	-11,120	45,250	9,330	4,090	-12,090	39,560	10,740	5,500	-13,500	31,530	12,870	7,630	-15,630	19,970
12	1987	83,000	-15,000	5,520	2019	8,360	2,840	-17,840	27,410	9,420	3,900	-18,900	20,660	10,980	5,460	-20,460	11,070	13,380	7,860	-22,860	-2,890
13	1988	80,000	-3,000	5,640	2020	8,360	2,720	-5,720	21,690	9,510	3,870	-6,870	13,790	11,240	5,600	-8,600	2,470	13,920	8,280	-11,280	-14,170
14	1989	59,000	-21,000	5,840	2021	8,360	2,520	-23,520	-1,830	9,610	3,770	-24,770	-10,980	11,490	5,650	-26,650	-24,180	14,480	8,640	-29,640	-43,810
15	1990	62,000	3,000	6,500	2022	8,360	1,860	1,140	-690	9,710	3,210	-210	-11,190	11,760	5,260	-2,260	-26,440	15,060	8,560	-5,560	-49,370
16	1991	62,000	0	6,070	2023	8,360	2,290	-2,290	-2,980	9,800	3,730	-3,730	-14,920	12,030	5,960	-5,960	-32,400	15,660	9,590	-9,590	-58,960
17	1992	61,000	-1,000	6,070	2024	8,360	2,290	-3,290	-6,270	9,900	3,830	-4,830	-19,750	12,310	6,240	-7,240	-39,640	16,280	10,210	-11,210	-70,170
18	1993	72,000	11,000	5,980	2025	8,360	2,380	8,620	2,350	10,000	4,020	6,980	-12,770	12,590	6,610	4,390	-35,250	16,940	10,960	40	-70,130
19	1994	60,000	-12,000	6,110	2026	8,360	2,250	-14,250	-11,900	10,100	3,990	-15,990	-28,760	12,880	6,770	-18,770	-54,020	17,610	11,500	-23,500	-93,630
20	1995	87,000	27,000	5,860	2027	8,360	2,500	24,500	12,600	10,200	4,340	22,660	-6,100	13,170	7,310	19,690	-34,330	18,320	12,460	14,540	-79,090
21	1996	76,000	-11,000	6,260	2028	8,360	2,100	-13,100	-500	10,300	4,040	-15,040	-21,140	13,480	7,220	-18,220	-52,550	19,050	12,790	-23,790	-102,880
22	1997	N/A	14,500	6,360	2029	8,360	2,000	12,500	12,000	10,410	4,050	10,450	-10,690	13,790	7,430	7,070	-45,480	19,810	13,450	1,050	-101,830
23	1998	105,000	14,500	6,640	2030	8,360	1,720	12,780	24,780	10,510	3,870	10,630	-60	14,100	7,460	7,040	-38,440	20,610	13,970	530	-101,300
24	1999	106,000	1,000	7,250	2031	8,360	1,110	-110	24,670	10,610	3,360	-2,360	-2,420	14,430	7,180	-6,180	-44,620	21,430	14,180	-13,180	-114,480
25	2000	108,000	2,000	7,420	2032	8,360	940	1,060	25,730	10,720	3,300	-1,300	-3,720	14,760	7,340	-5,340	-49,960	22,290	14,870	-12,870	-127,350
26	2001	118,000	10,000	7,650	2033	8,360	710	9,290	35,020	10,830	3,180	6,820	3,100	15,100	7,450	2,550	-47,410	23,180	15,530	-5,530	-132,880
27	2002	96,000	-22,000	8,380	2034	8,360	-20	-21,980	13,040	10,940	2,560	-24,560	-21,460	15,450	7,070	-29,070	-76,480	24,100	15,720	-37,720	-170,600
28	2003	94,000	-2,000	8,390	2035	8,360	-30	-1,970	11,070	11,050	2,660	-4,660	-26,120	15,800	7,410	-9,410	-85,890	25,070	16,680	-18,680	-189,280
29	2004	89,000	-5,000	8,660	2036	8,360	-300	-4,700	6,370	11,160	2,500	-7,500	-33,620	16,170	7,510	-12,510	-98,400	26,070	17,410	-22,410	-211,690
30	2005	98,000	9,000	8,730	2037	8,360	-370	9,370	15,740	11,270	2,540	6,460	-27,160	16,540	7,810	1,190	-97,210	27,110	18,380	-9,380	-221,070
31	2006	107,000	9,000	9,380	2038	8,360	-1,020	10,020	25,760	11,380	2,000	7,000	-20,160	16,920	7,540	1,460	-95,750	28,200	18,820	-9,820	-230,890
32	2007	93,000	-14,000	10,650	2039	8,360	-2,290	-11,710	14,050	11,490	840	-14,840	-35,000	17,310	6,660	-20,660	-116,410	29,330	18,680	-32,680	-263,570
Total			-6,000	197,910		278,170	80,260	-78,950		327,220	129,310	-128,000		408,630	210,720	-209,410		555,790	357,880	-356,570	
Average			-190	6,000		8,430	2,430	-2,470		9,920	3,920	-4,000		12,380	6,390	-6,540		16,840	10,840	-11,140	

**Notes:**  
 Due to lack of available data, the change in groundwater storage was averaged between known values and split equally to the unknown values  
 N/A Data unavailable.  
**bold** Indicates first year in which the groundwater in storage is below sea level.  
 All numbers have been rounded to the nearest 10.

Predicted Groundwater in Storage Above Sea Level in Acre Feet  
 DRY HYDROLOGIC CONDITION

Historic Data					Scenario 1				Scenario 2				Scenario 3				Scenario 4				
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Index	Year	Storage	Change In Storage	Consumptive Use	Year	Consumptive Use 0% Annual Escalation Rate	Change In Consumptive Use	Change In Storage	Cumulative Storage	Consumptive Use 1% Annual Escalation Rate	Change In Consumptive Use	Change In Storage	Cumulative Storage	Consumptive Use 2.3% Annual Escalation Rate	Change In Consumptive Use	Change In Storage	Cumulative Storage	Consumptive Use 4% Annual Escalation Rate	Change In Consumptive Use	Change In Storage	Cumulative Storage
		Oct. 3, 2007 Memo	[C] - [C(prev)]	Hydro Inv updated 2007		2007 Consumptive Use	[G] - [E]	[D] - [H]	[J(prev)] + [I]	$10,650 * (1 + .01)^{[A]}$	[K] - [E]	[D] - [L]	[N(prev)] + [M]	$10,650 * (1 + .023)^{[A]}$	[O] - [E]	[D] - [P]	[R(prev)] + [Q]	$10,650 * (1 + .023)^{[A]}$	[S] - [E]	[D] - [T]	[V(prev)] + [U]
0					2007	10,650			93,000	10,650			93,000	10,650			93,000	10,650			93,000
1	1986	98,000	-8,000	5,240	2008	10,650	5,410	-13,410	79,590	10,760	5,520	-13,520	79,480	10,890	5,650	-13,650	79,350	11,080	5,840	-13,840	79,160
2	1987	83,000	-15,000	5,520	2009	10,650	5,130	-20,130	59,460	10,860	5,340	-20,340	59,140	11,150	5,630	-20,630	58,720	11,520	6,000	-21,000	58,160
3	1988	80,000	-3,000	5,640	2010	10,650	5,010	-8,010	51,450	10,970	5,330	-8,330	50,810	11,400	5,760	-8,760	49,960	11,980	6,340	-9,340	48,820
4	1989	59,000	-21,000	5,840	2011	10,650	4,810	-25,810	25,640	11,080	5,240	-26,240	24,570	11,660	5,820	-26,820	23,140	12,460	6,620	-27,620	21,200
5	1990	62,000	3,000	6,500	2012	10,650	4,150	-1,150	24,490	11,190	4,690	-1,690	22,880	11,930	5,430	-2,430	20,710	12,960	6,460	-3,460	17,740
6	1991	62,000	0	6,070	2013	10,650	4,580	-4,580	19,910	11,310	5,240	-5,240	17,640	12,210	6,140	-6,140	14,570	13,480	7,410	-7,410	10,330
7	1992	61,000	-1,000	6,070	2014	10,650	4,580	-5,580	14,330	11,420	5,350	-6,350	11,290	12,490	6,420	-7,420	7,150	14,010	7,940	-8,940	1,390
8	1976	82,000	-17,000	3,480	2015	10,650	7,170	-24,170	-9,840	11,530	8,050	-25,050	-13,760	12,770	9,290	-26,290	-19,140	14,580	11,100	-28,100	-26,710
9	1977	64,000	-18,000	3,760	2016	10,650	6,890	-24,890	-34,730	11,650	7,890	-25,890	-39,650	13,070	9,310	-27,310	-46,450	15,160	11,400	-29,400	-56,110
10	1978	84,000	20,000	3,470	2017	10,650	7,180	12,820	-21,910	11,760	8,290	11,710	-27,940	13,370	9,900	10,100	-36,350	15,760	12,290	7,710	-48,400
11	1979	72,000	-12,000	3,800	2018	10,650	6,850	-18,850	-40,760	11,880	8,080	-20,080	-48,020	13,680	9,880	-21,880	-58,230	16,400	12,600	-24,600	-73,000
12	1980	88,000	16,000	3,920	2019	10,650	6,730	9,270	-31,490	12,000	8,080	7,920	-40,100	13,990	10,070	5,930	-52,300	17,050	13,130	2,870	-70,130
13	1981	97,000	9,000	4,050	2020	10,650	6,600	2,400	-29,090	12,120	8,070	930	-39,170	14,310	10,260	-1,260	-53,560	17,730	13,680	-4,680	-74,810
14	1982	123,000	26,000	4,170	2021	10,650	6,480	19,520	-9,570	12,240	8,070	17,930	-21,240	14,640	10,470	15,530	-38,030	18,440	14,270	11,730	-63,080
15	1995	87,000	27,000	5,860	2022	10,650	4,790	22,210	12,640	12,360	6,500	20,500	-740	14,980	9,120	17,880	-20,150	19,180	13,320	13,680	-49,400
16	1996	76,000	-11,000	6,260	2023	10,650	4,390	-15,390	-2,750	12,490	6,230	-17,230	-17,970	15,320	9,060	-20,060	-40,210	19,950	13,690	-24,690	-74,090
17	1997	NA	14,500	6,360	2024	10,650	4,290	10,210	7,460	12,610	6,250	8,250	-9,720	15,680	9,320	5,180	-35,030	20,750	14,390	110	-73,980
18	1998	105,000	14,500	6,640	2025	10,650	4,010	10,490	17,950	12,740	6,100	8,400	-1,320	16,040	9,400	5,100	-29,930	21,570	14,930	-430	-74,410
19	1999	106,000	1,000	7,250	2026	10,650	3,400	-2,400	15,550	12,870	5,620	-4,620	-5,940	16,410	9,160	-8,160	-38,090	22,440	15,190	-14,190	-88,600
20	2000	108,000	2,000	7,420	2027	10,650	3,230	-1,230	14,320	13,000	5,580	-3,580	-9,520	16,780	9,360	-7,360	-45,450	23,340	15,920	-13,920	-102,520
21	2001	118,000	10,000	7,650	2028	10,650	3,000	7,000	21,320	13,120	5,470	4,530	-4,990	17,170	9,520	480	-44,970	24,270	16,620	-6,620	-109,140
Total			37,000	114,970		234,300	108,680	-71,680		260,610	134,990	-97,990		300,590	174,970	-137,970		364,760	239,140	-202,140	
Average			-1,760	5,470		10,650	5,180	-3,410		11,850	6,430	-4,670		13,660	8,330	-6,570		16,580	11,390	-9,630	

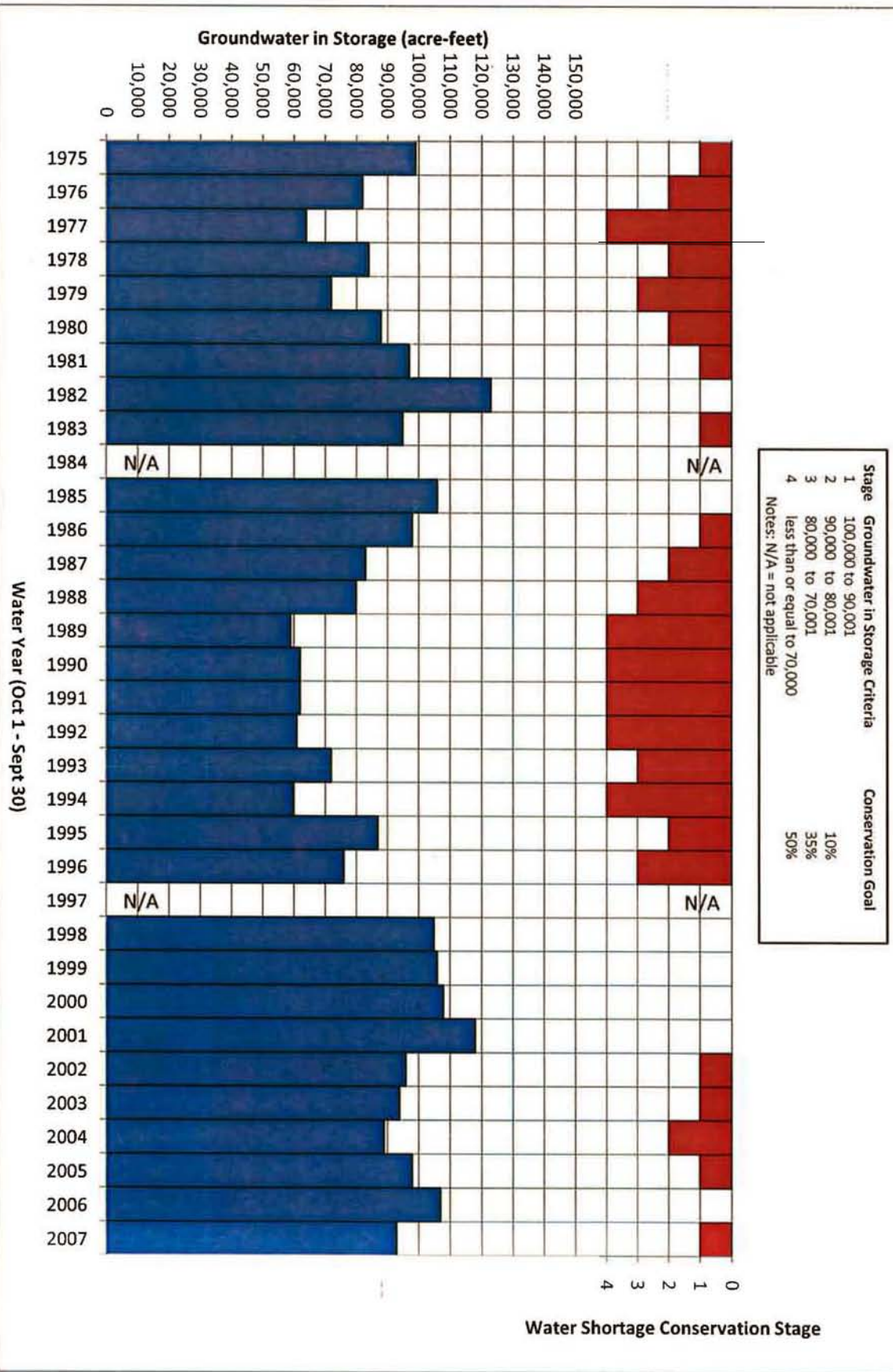
Notes:  
 N/A Data unavailable.  
 bold Indicates first year in which the groundwater in storage is below sea level.  
 All numbers have been rounded to the nearest 10.

Predicted Groundwater in Storage Above Sea Level in Acre Feet  
WET HYDROLOGIC CONDITION

Historic Data					Scenario 1				Scenario 2				Scenario 3				Scenario 4				
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Index	Year	Storage	Change in Storage	Consumptive Use	Year	Consumptive Use 0% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage	Consumptive Use 1% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage	Consumptive Use 2.3% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage	Consumptive Use 4% Annual Escalation Rate	Change in Consumptive Use	Change in Storage	Cumulative Storage
		Oct. 3, 2007 Memo	Historic Value	Hydro Inv updated 2007		2007 Consumptive Use	[G] - [E]	[D] - [H]	[J(prev)] + [I]	$10,650 \cdot (1+.01)^{[A]}$	[K] - [E]	[D] - [L]	[N(prev)] + [M]	$10,650 \cdot (1+.023)^{[A]}$	[O] - [E]	[D] - [P]	[R(prev)] + [Q]	$10,650 \cdot (1+.023)^{[A]}$	[S] - [E]	[D] - [T]	[V(prev)] + [U]
0					2007	10,650			93,000	10,650			93,000	10,650			93,000	10,650			93,000
1	1995	87,000	27,000	5,860	2008	10,650	4,790	22,210	115,210	10,760	4,900	22,100	115,100	10,890	5,030	21,970	114,970	11,080	5,220	21,780	114,780
2	1996	76,000	-11,000	6,260	2009	10,650	4,390	-15,390	99,820	10,860	4,600	-15,600	99,500	11,150	4,890	-15,890	99,080	11,520	5,260	-16,260	98,520
3	1997	N/A	14,500	6,360	2010	10,650	4,290	10,210	110,030	10,970	4,610	9,890	109,390	11,400	5,040	9,460	108,540	11,980	5,620	8,880	107,400
4	1998	105,000	14,500	6,640	2011	10,650	4,010	10,490	120,520	11,080	4,440	10,060	119,450	11,660	5,020	9,480	118,020	12,460	5,820	8,680	116,080
5	1999	106,000	1,000	7,250	2012	10,650	3,400	-2,400	118,120	11,190	3,940	-2,940	116,510	11,930	4,680	-3,680	114,340	12,960	5,710	-4,710	111,370
6	2000	108,000	2,000	7,420	2013	10,650	3,230	-1,230	116,890	11,310	3,890	-1,890	114,620	12,210	4,790	-2,790	111,550	13,480	6,060	-4,060	107,310
7	2001	118,000	10,000	7,650	2014	10,650	3,000	7,000	123,890	11,420	3,770	6,230	120,850	12,490	4,840	5,160	116,710	14,010	6,360	3,640	110,950
8	1978	84,000	20,000	3,470	2015	10,650	7,180	12,820	136,710	11,530	8,060	11,940	132,790	12,770	9,300	10,700	127,410	14,580	11,110	8,890	119,840
9	1979	72,000	-12,000	3,800	2016	10,650	6,850	-18,850	117,860	11,650	7,850	-19,850	112,940	13,070	9,270	-21,270	106,140	15,160	11,360	-23,360	96,480
10	1980	88,000	16,000	3,920	2017	10,650	6,730	9,270	127,130	11,760	7,840	8,160	121,100	13,370	9,450	6,550	112,690	15,760	11,840	4,160	100,640
11	1981	97,000	9,000	4,050	2018	10,650	6,600	2,400	129,530	11,880	7,830	1,170	122,270	13,680	9,630	-630	112,060	16,400	12,350	-3,350	97,290
12	1982	123,000	26,000	4,170	2019	10,650	6,480	19,520	149,050	12,000	7,830	18,170	140,440	13,990	9,820	16,180	128,240	17,050	12,880	13,120	110,410
13	1976	82,000	-17,000	3,480	2020	10,650	7,170	-24,170	124,880	12,120	8,640	-25,640	114,800	14,310	10,830	-27,830	100,410	17,730	14,250	-31,250	79,160
14	1977	64,000	-18,000	3,760	2021	10,650	6,890	-24,890	99,990	12,240	8,480	-26,480	88,320	14,640	10,880	-28,880	71,530	18,440	14,680	-32,680	46,480
15	1986	98,000	-8,000	5,240	2022	10,650	5,410	-13,410	86,580	12,360	7,120	-15,120	73,200	14,980	9,740	-17,740	53,790	19,180	13,940	-21,940	24,540
16	1987	83,000	-15,000	5,520	2023	10,650	5,130	-20,130	66,450	12,490	6,970	-21,970	51,230	15,320	9,800	-24,800	28,990	19,950	14,430	-29,430	-4,890
17	1988	80,000	-3,000	5,640	2024	10,650	5,010	-8,010	58,440	12,610	6,970	-9,970	41,260	15,680	10,040	-13,040	15,950	20,750	15,110	-18,110	-23,000
18	1989	59,000	-21,000	5,840	2025	10,650	4,810	-25,810	32,630	12,740	6,900	-27,900	13,360	16,040	10,200	-31,200	-15,250	21,570	15,730	-36,730	-59,730
19	1990	62,000	3,000	6,500	2026	10,650	4,150	-1,150	31,480	12,870	6,370	-3,370	9,990	16,410	9,910	-6,910	-22,160	22,440	15,940	-12,940	-72,670
20	1991	62,000	0	6,070	2027	10,650	4,580	-4,580	26,900	13,000	6,930	-6,930	3,060	16,780	10,710	-10,710	-32,870	23,340	17,270	-17,270	-89,940
21	1992	61,000	-1,000	6,070	2028	10,650	4,580	-5,580	21,320	13,120	7,050	-8,050	-4,990	17,170	11,100	-12,100	-44,970	24,270	18,200	-19,200	-109,140
Total			37,000	114,970		234,300	108,680	-71,680		260,610	134,990	-97,990		300,590	174,970	-137,970		364,760	239,140	-202,140	
Average			1,760	5,470		10,650	5,180	-3,410		11,850	6,430	-4,670		13,660	8,330	-6,570		16,580	11,390	-9,630	

Notes:  
 N/A Data unavailable.  
 bold Indicates first year in which the groundwater in storage is below sea level.  
 All numbers have been rounded to the nearest 10.

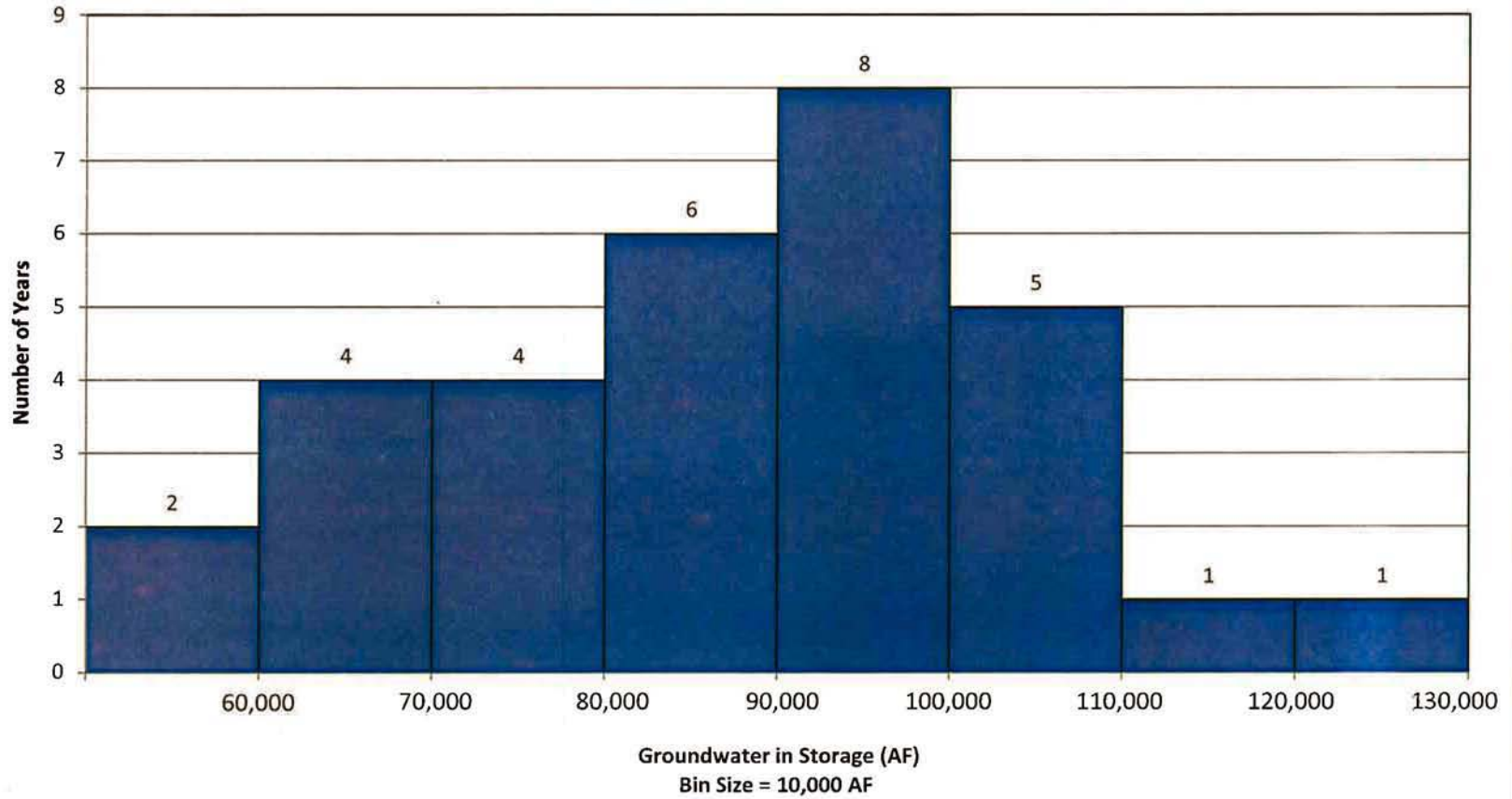
**Water Shortage Conservation Stages based on  
Estimates of Annual Groundwater in Storage 1975-2007**



Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	10%
2	90,000 to 80,001	35%
3	80,000 to 70,001	50%
4	less than or equal to 70,000	50%

Notes: N/A = not applicable

### Distribution of Annual Groundwater in Storage 1975 to 2007



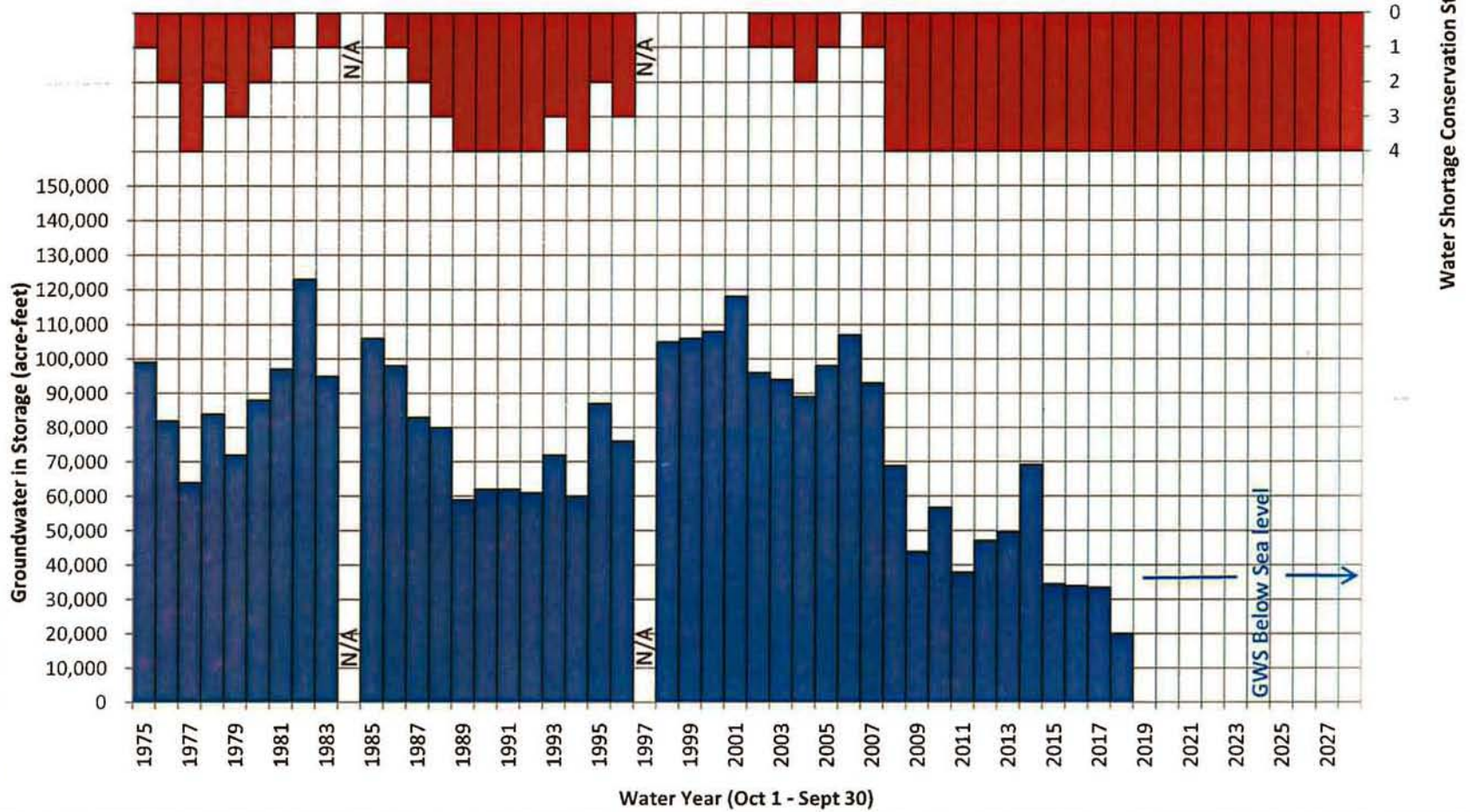
**NOTES:**

Total number of data points = 31

**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 1 - Historical Hydrologic Conditions**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

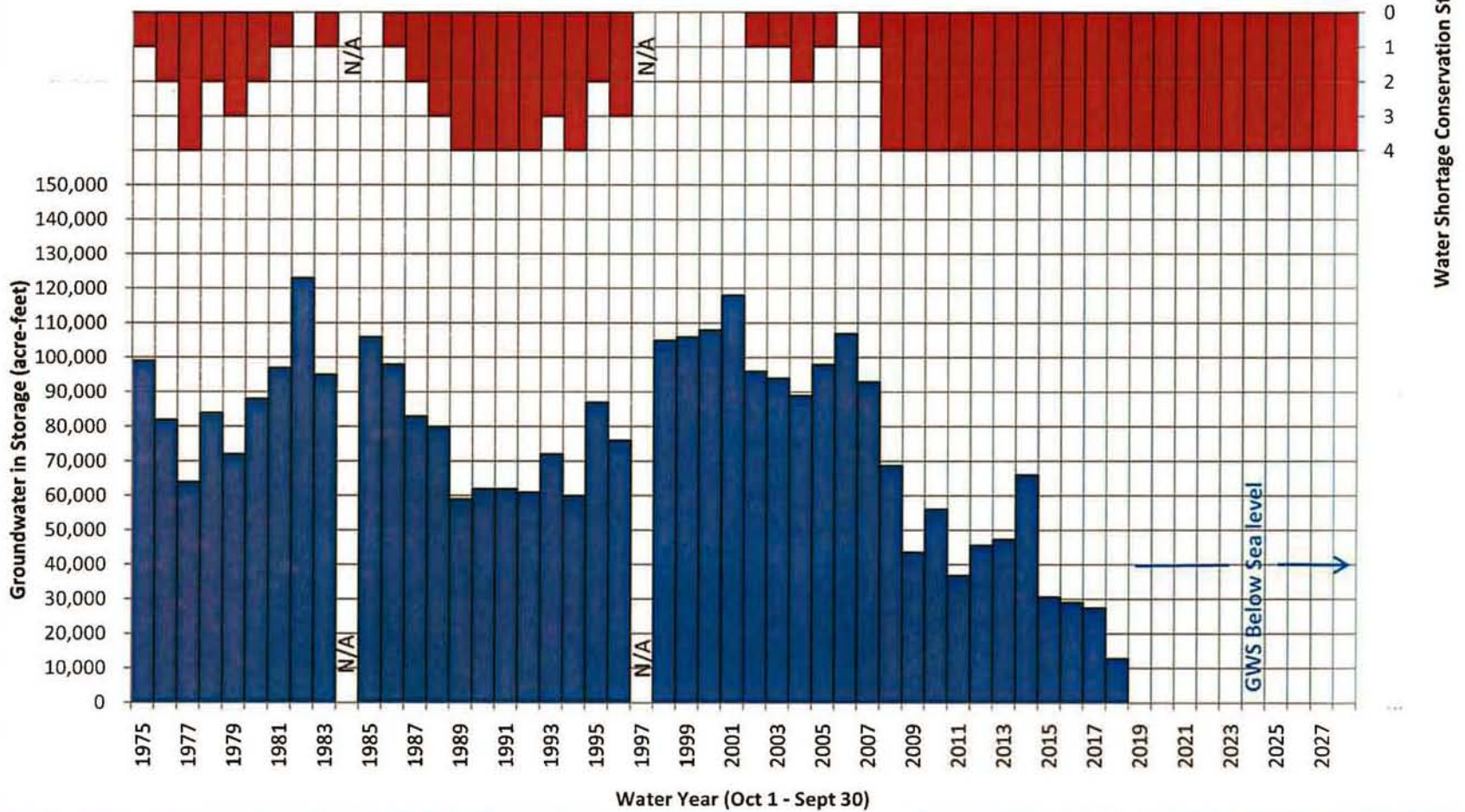
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 2 - Historical Hydrologic Conditions**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

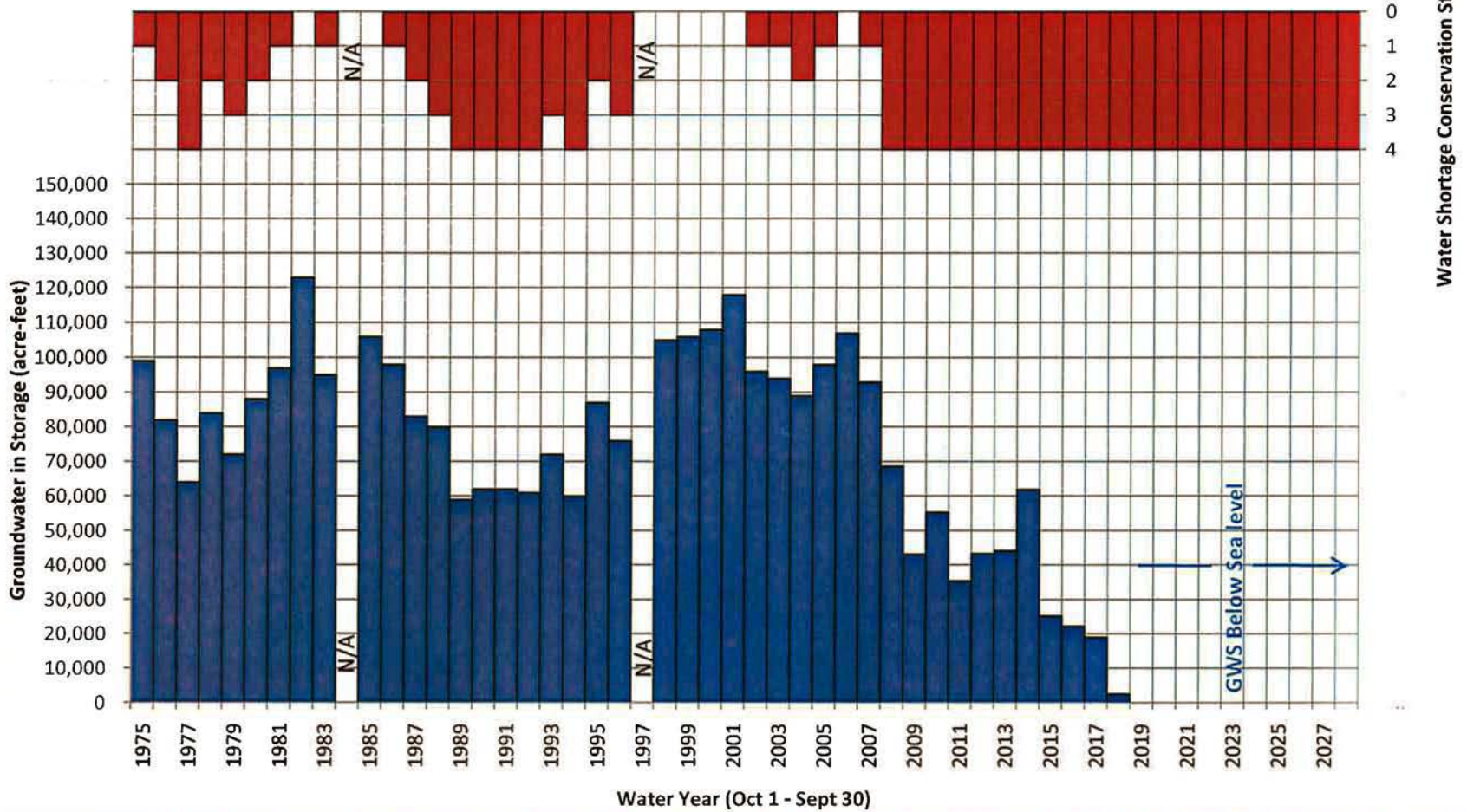
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 3 - Historical Hydrologic Conditions**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

Notes: N/A = not applicable

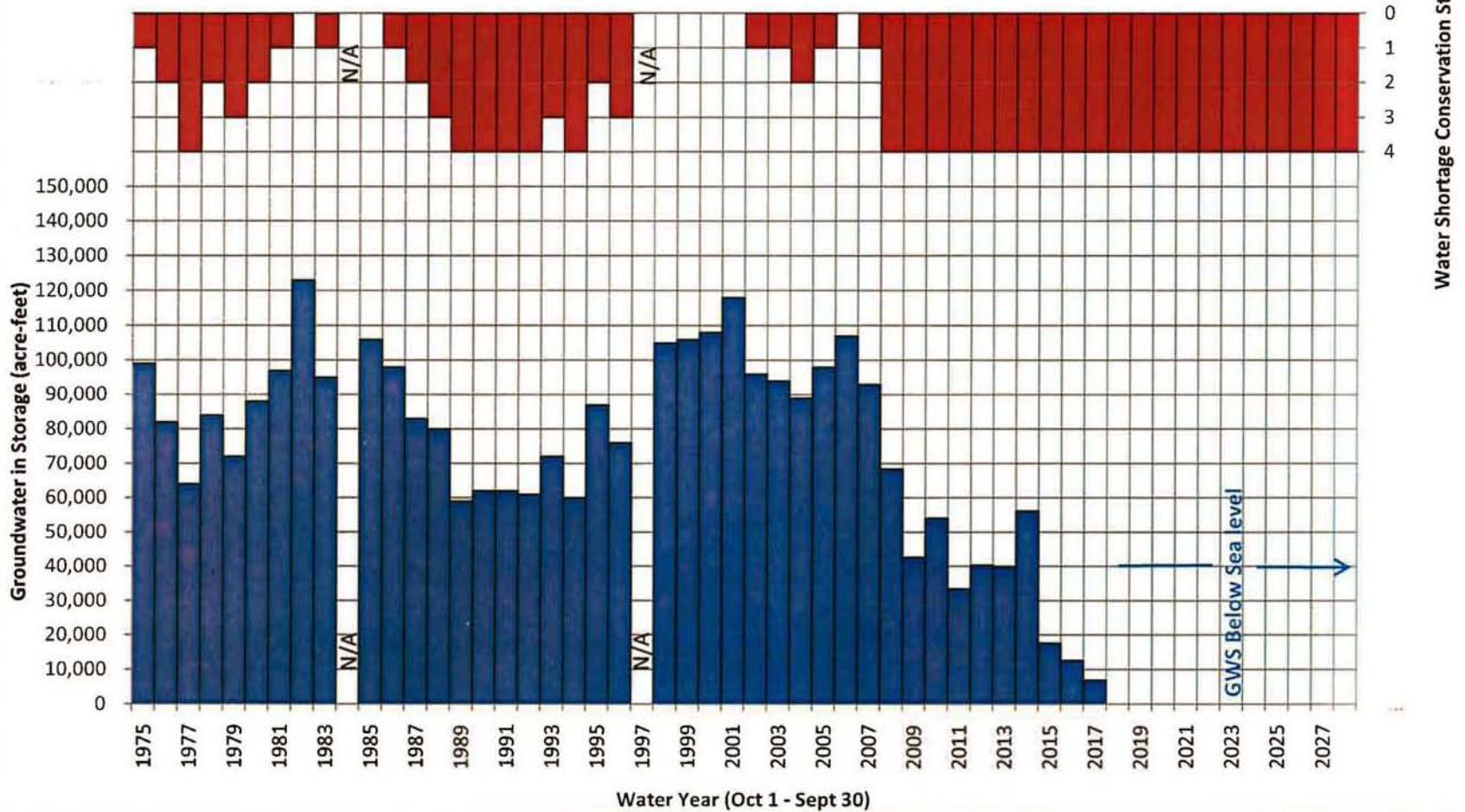




**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 4 - Historical Hydrologic Conditions**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

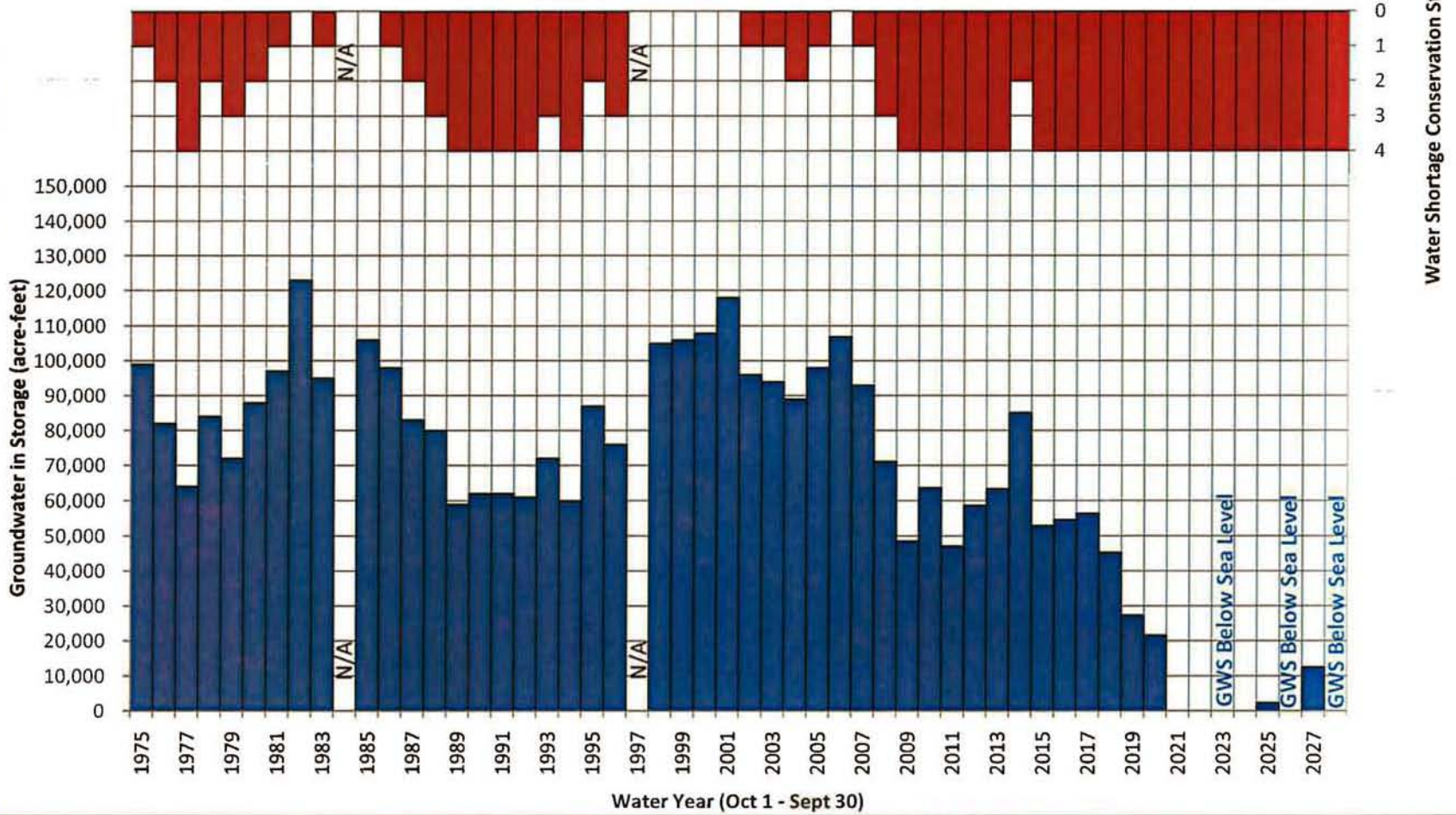
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 1 - 50% Reduction of Urban Water Consumptive Use**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

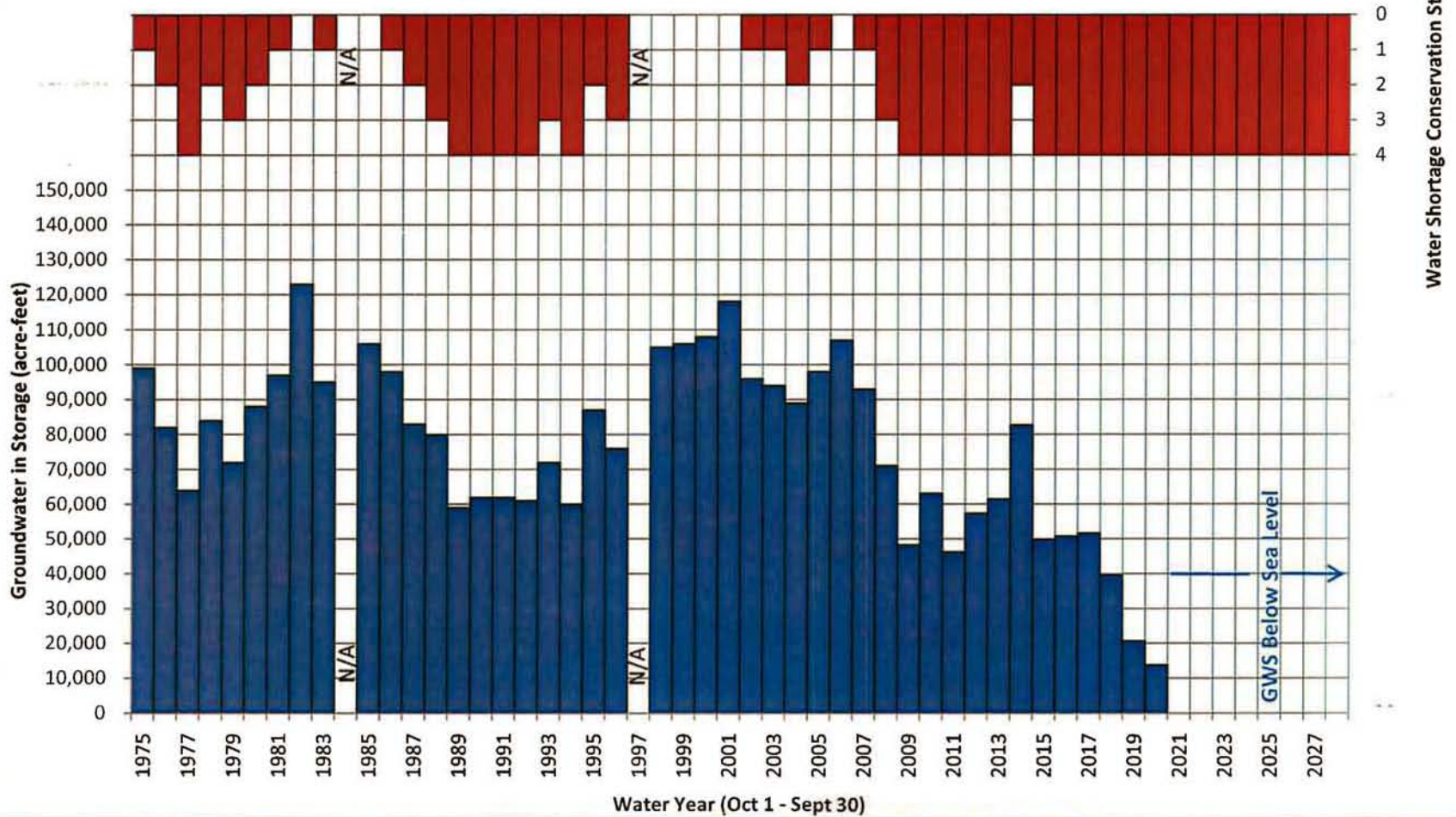
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 2 - 50% Reduction of Urban Water Consumptive Use**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

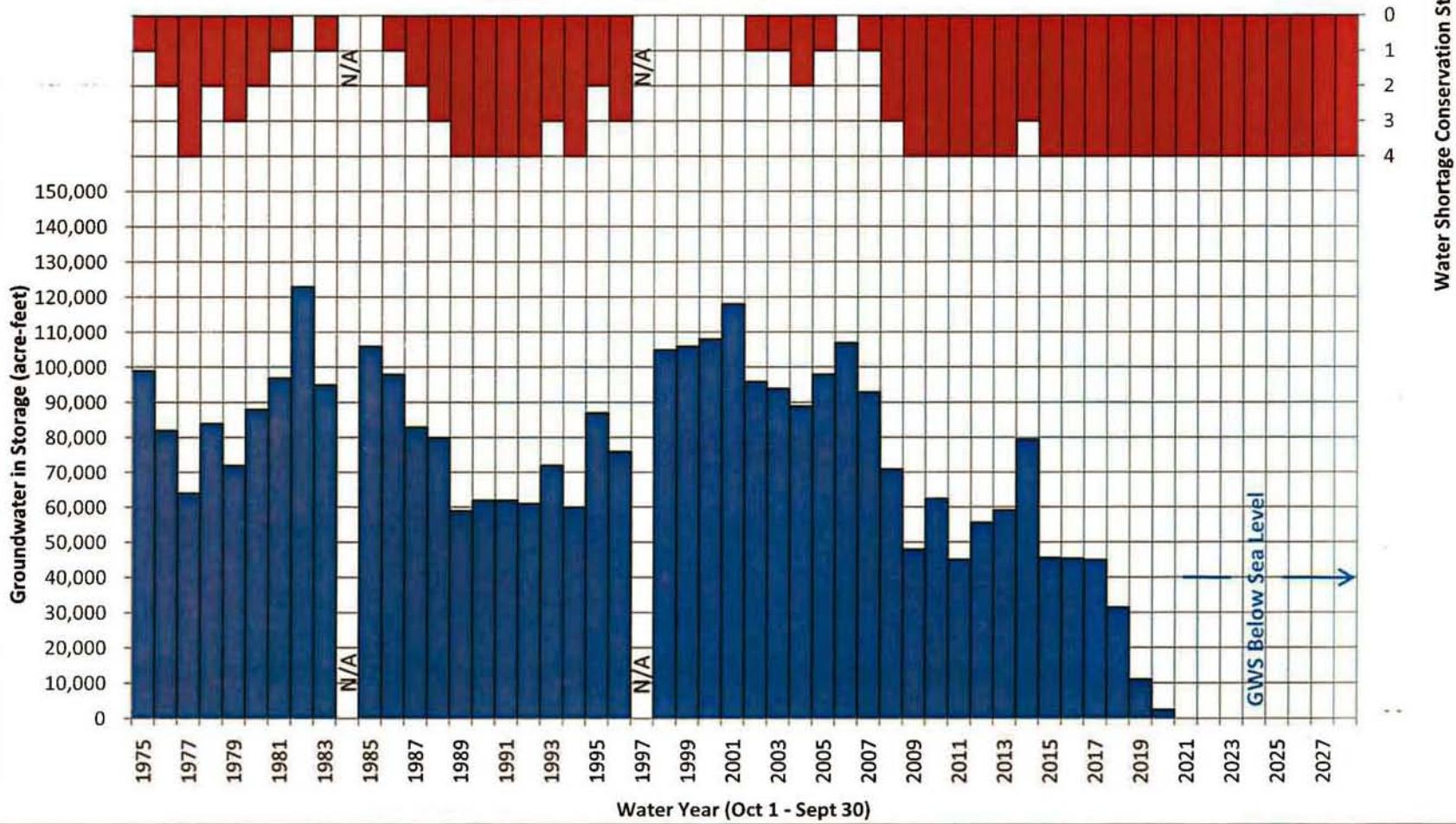
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 3 - 50% Reduction of Urban Water Consumptive Use**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

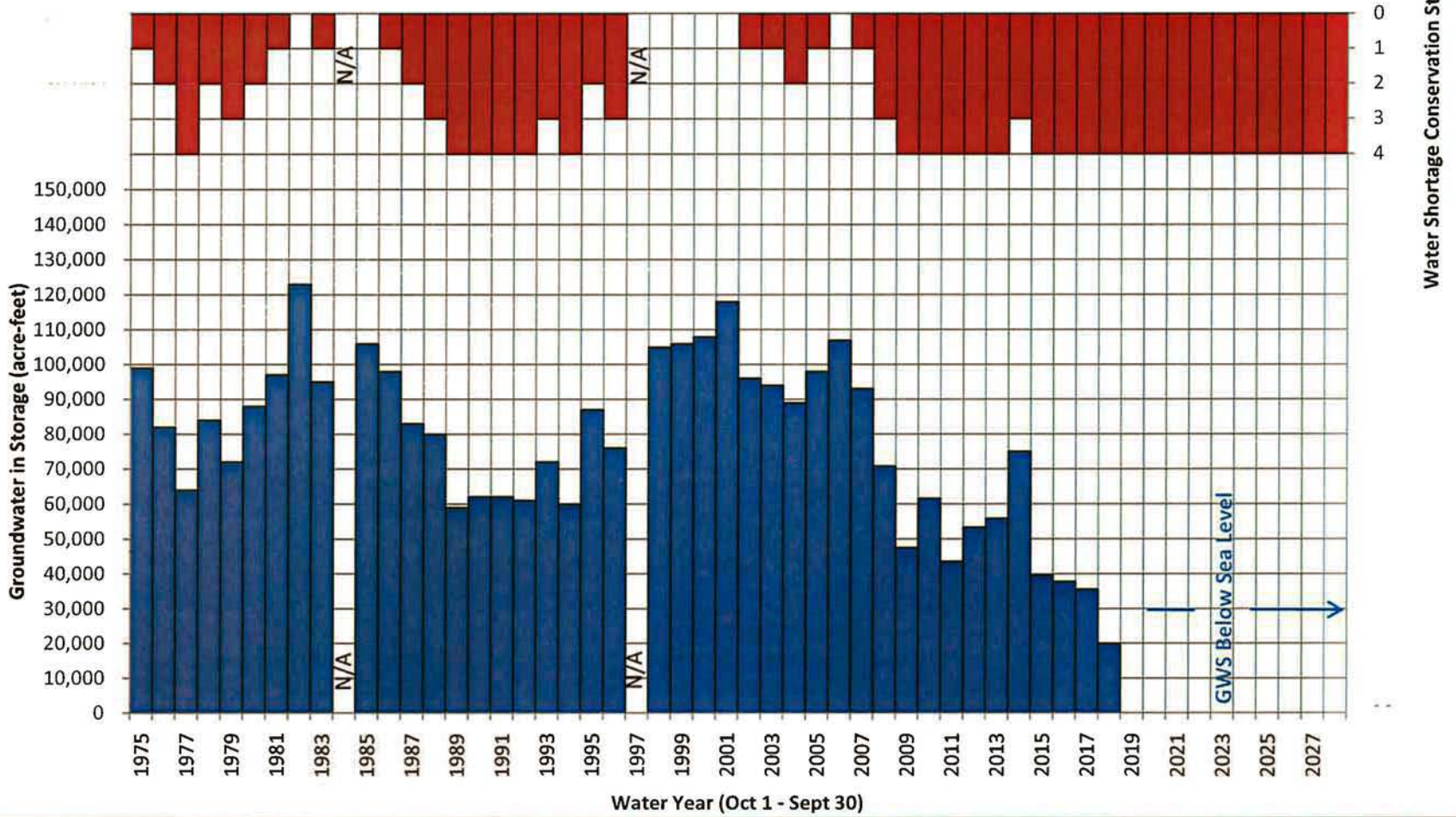
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 4 - 50% Reduction of Urban Water Consumptive Use**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

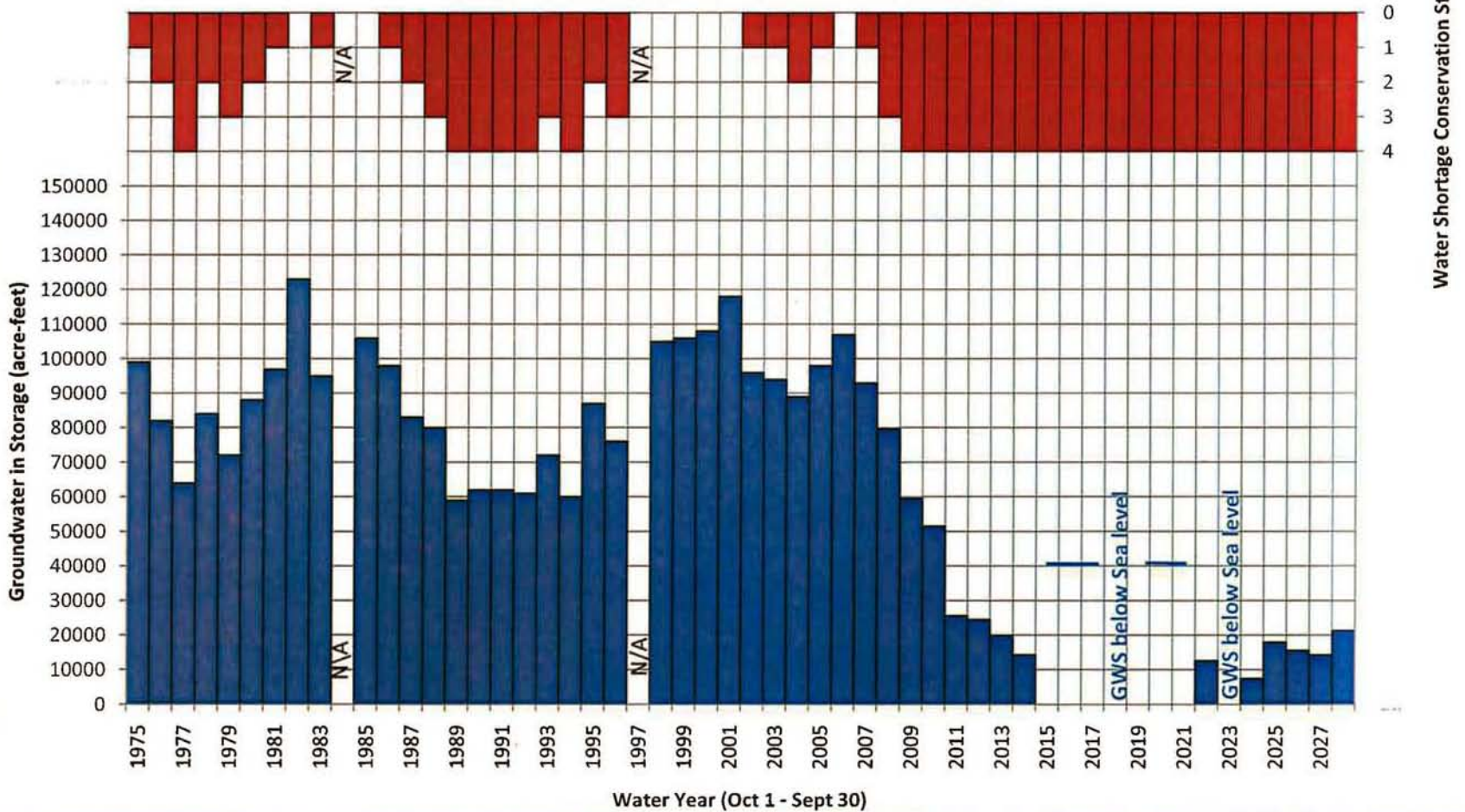
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 1 - Dry Hydrologic Condition**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

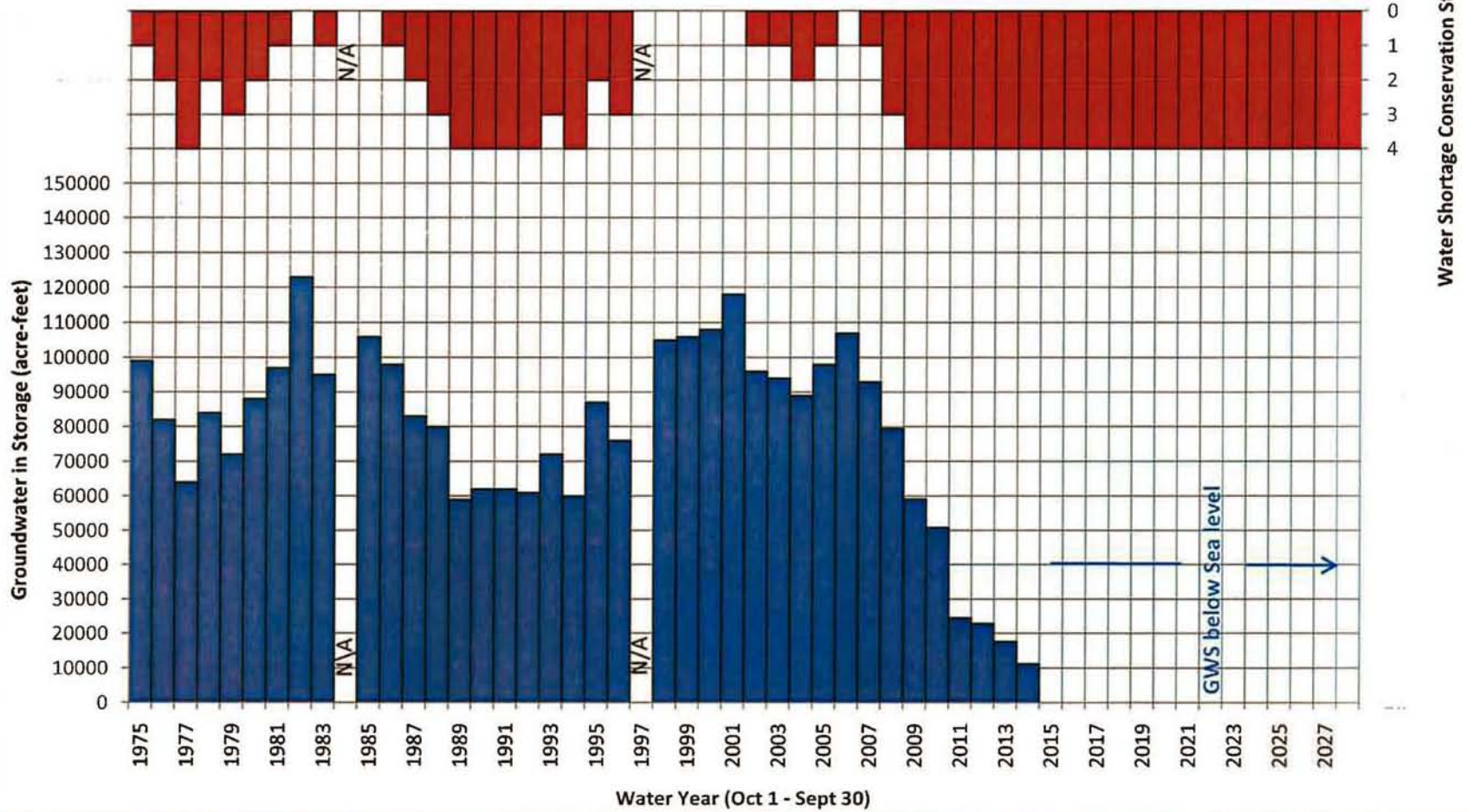
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 2 - Dry Hydrologic Condition**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

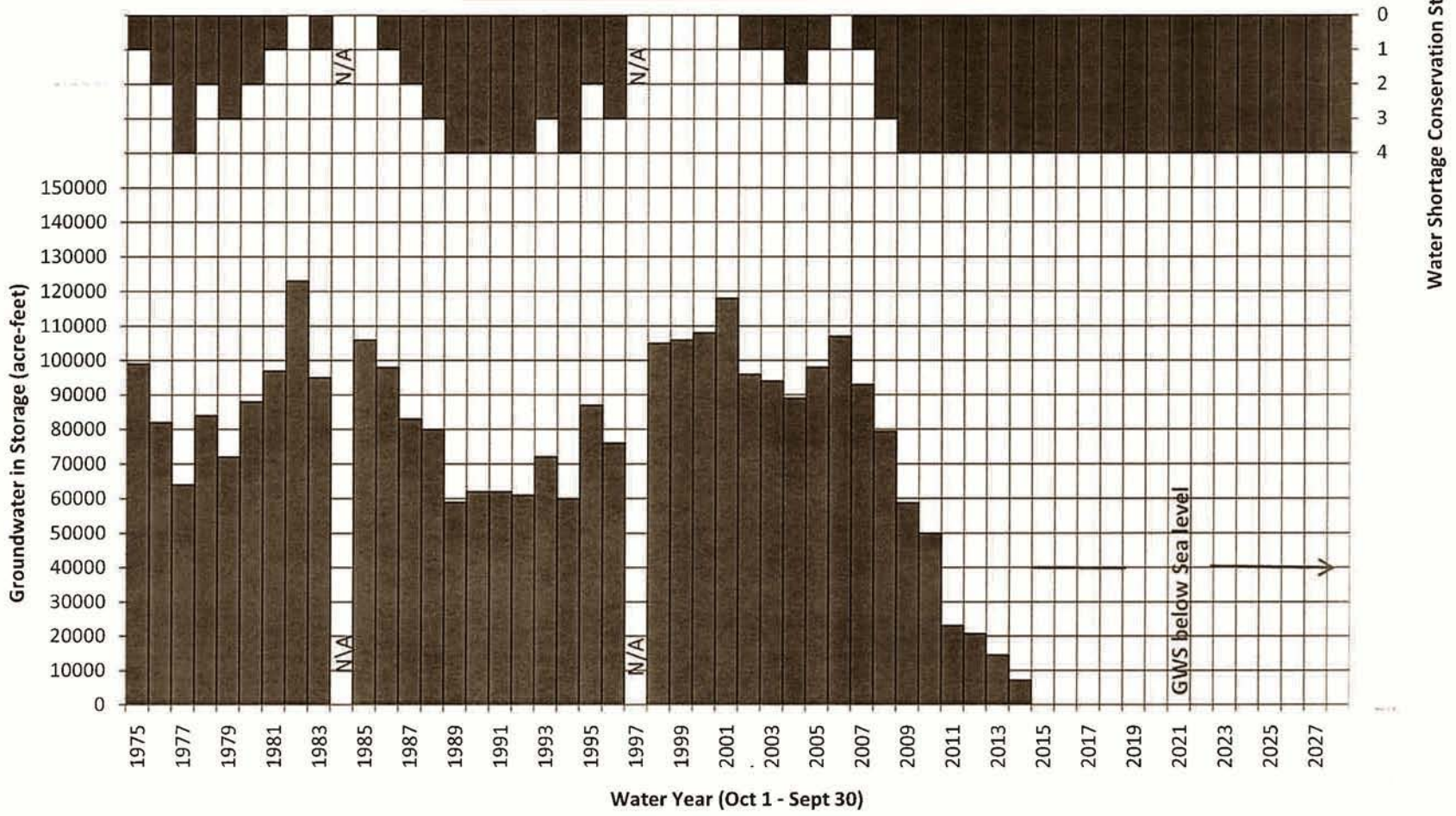
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 3 - Dry Hydrologic Condition**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

Notes: N/A = not applicable

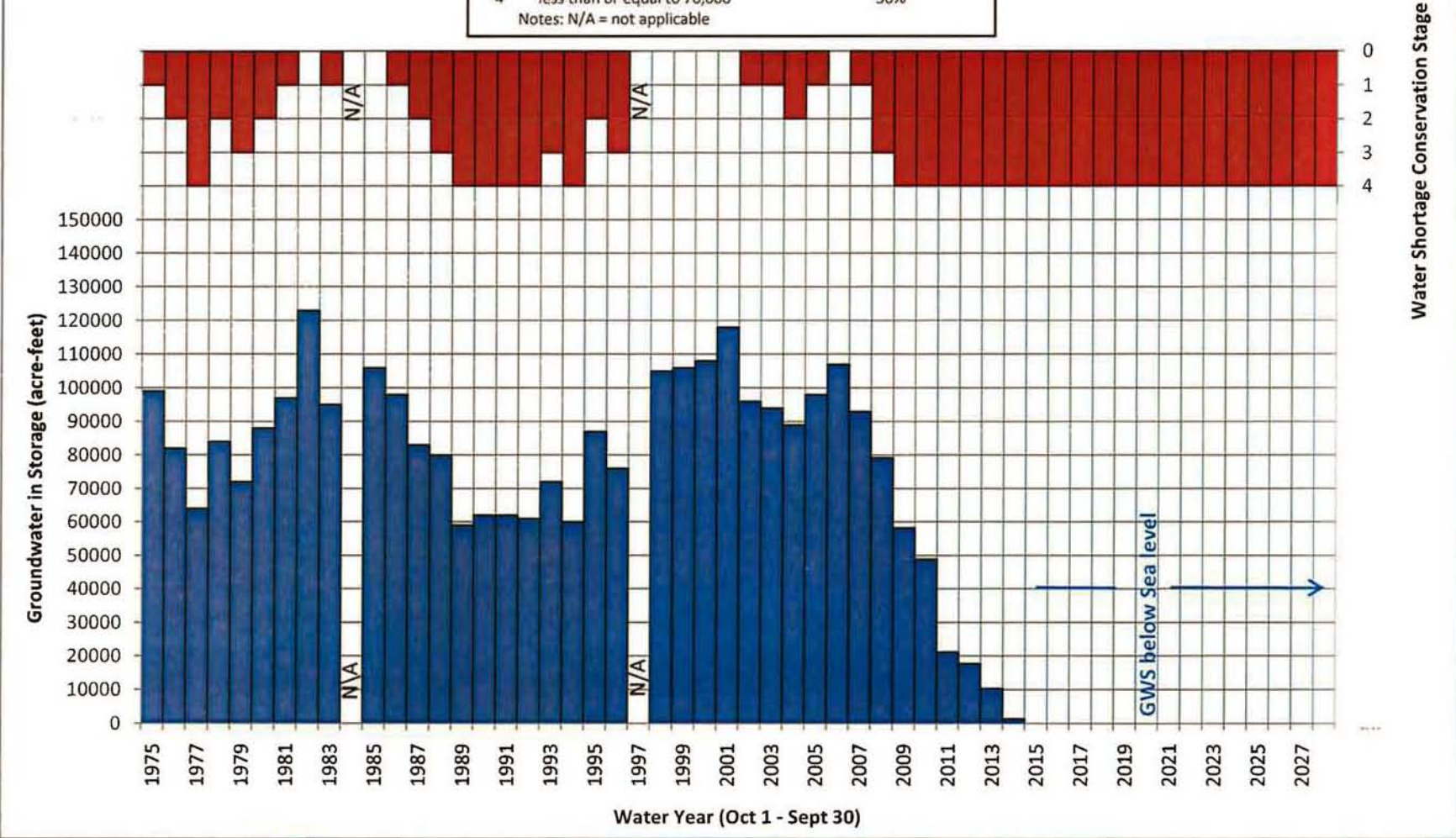




**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 4 - Dry Hydrologic Condition**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

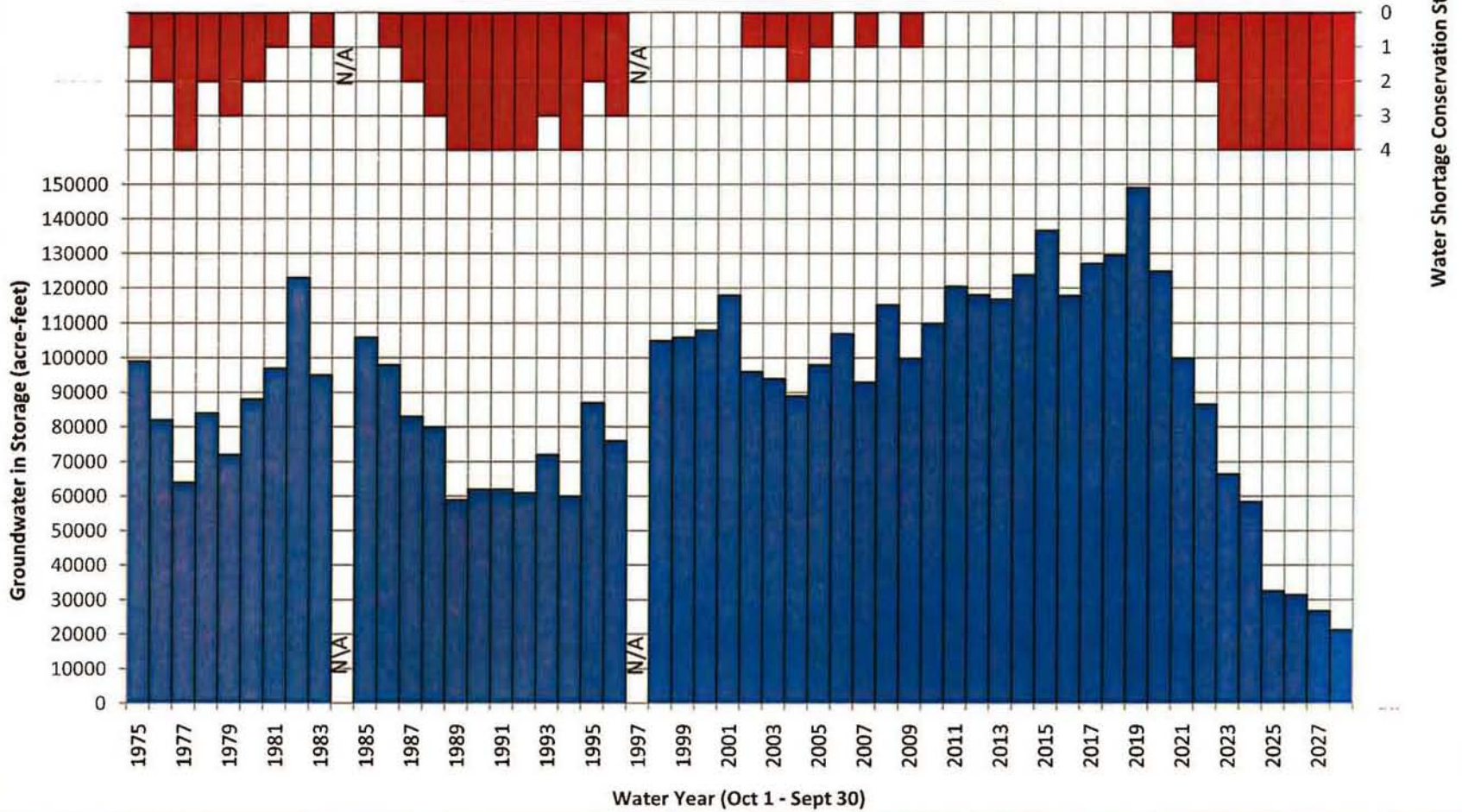
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 1 - Wet Hydrologic Condition**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

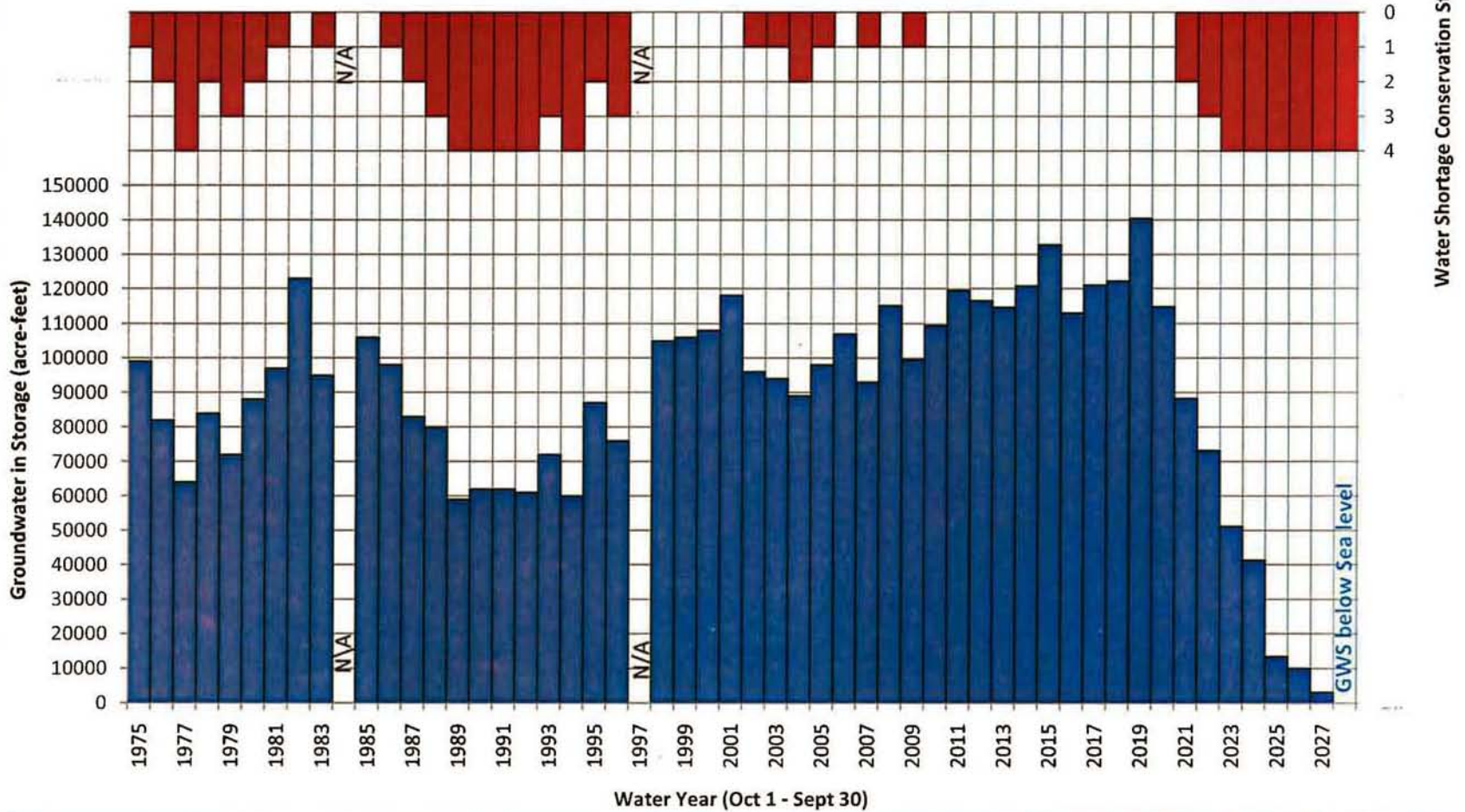
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 2 - Wet Hydrologic Condition**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

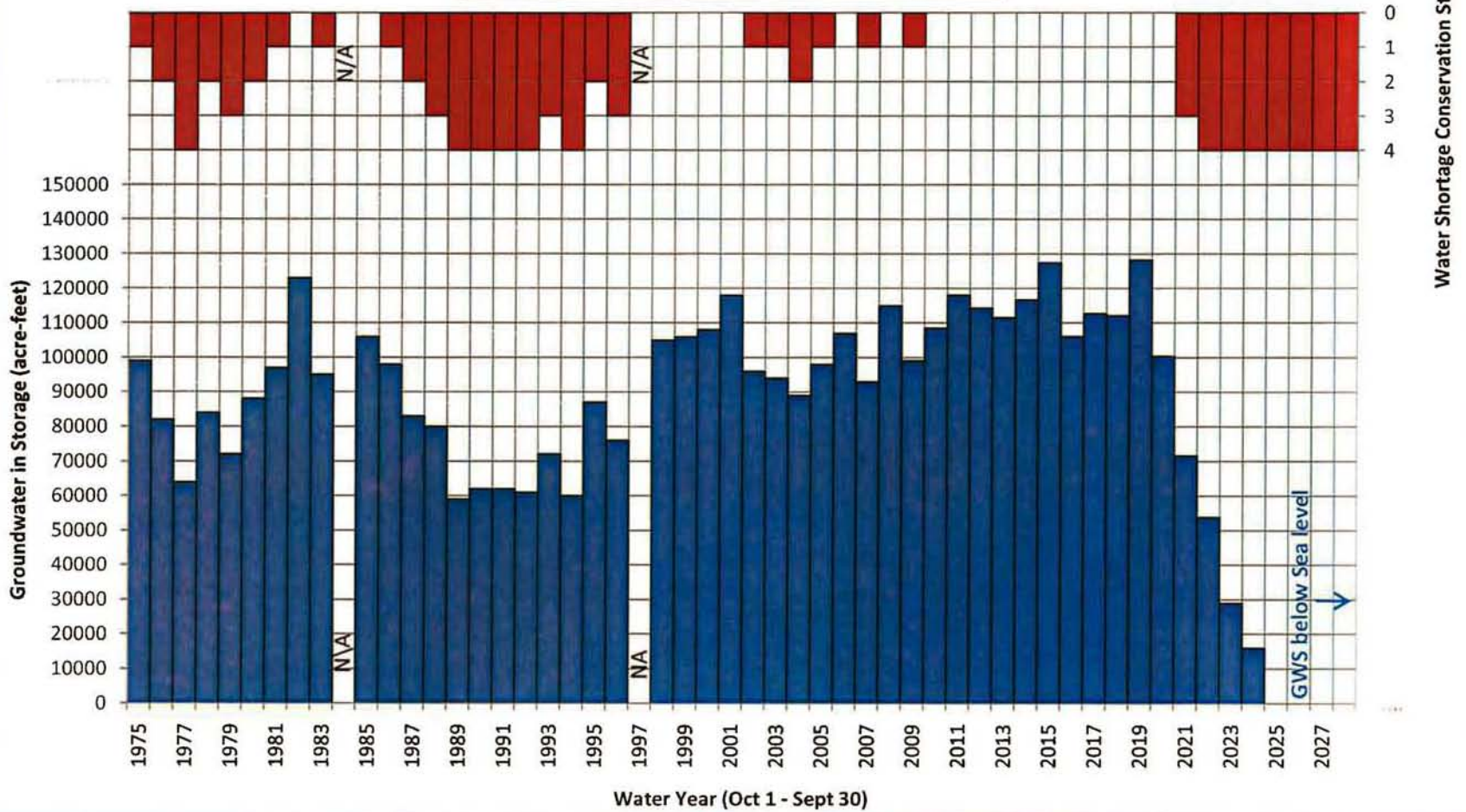
Notes: N/A = not applicable



**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 3 - Wet Hydrologic Condition**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

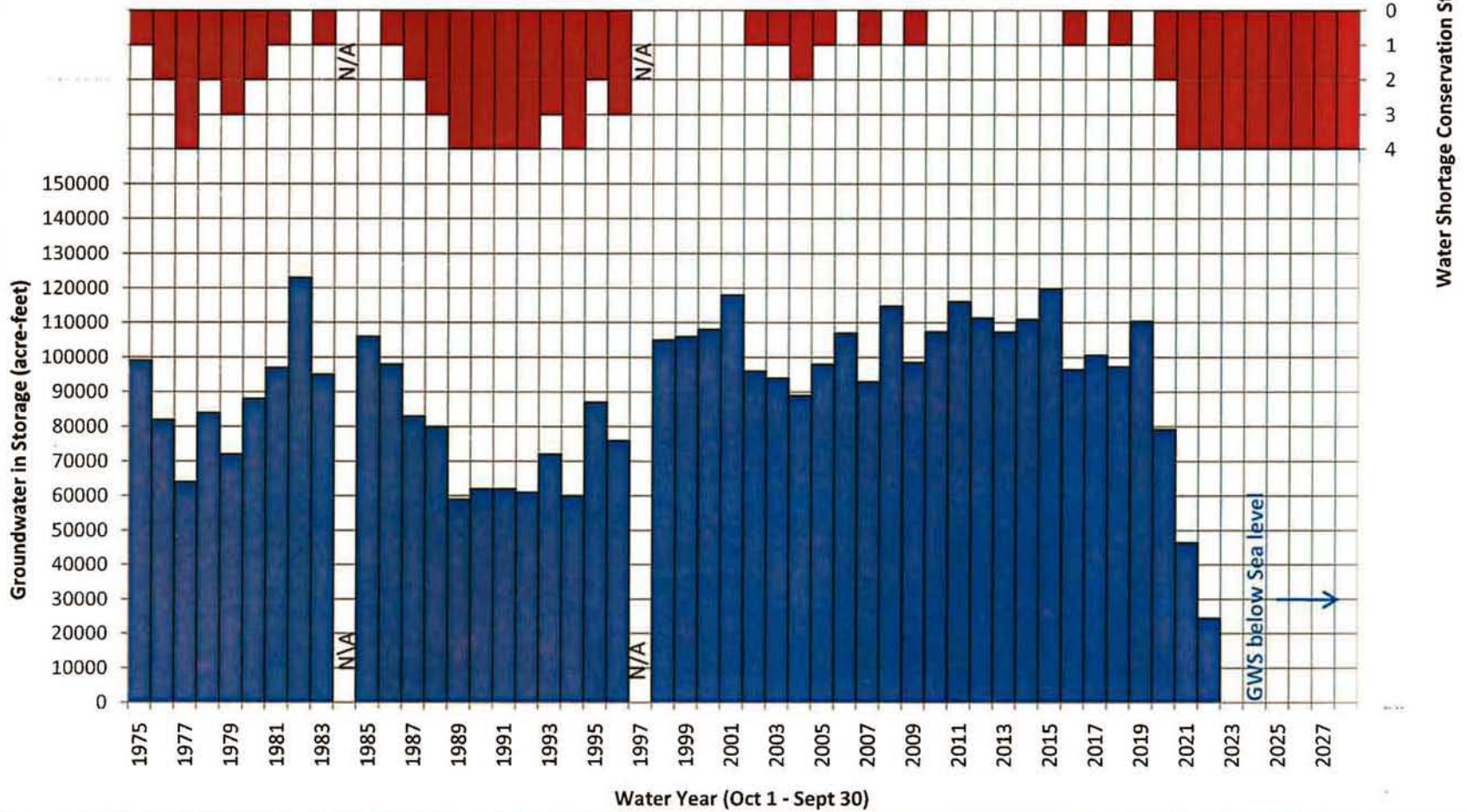
Notes: N/A = not applicable



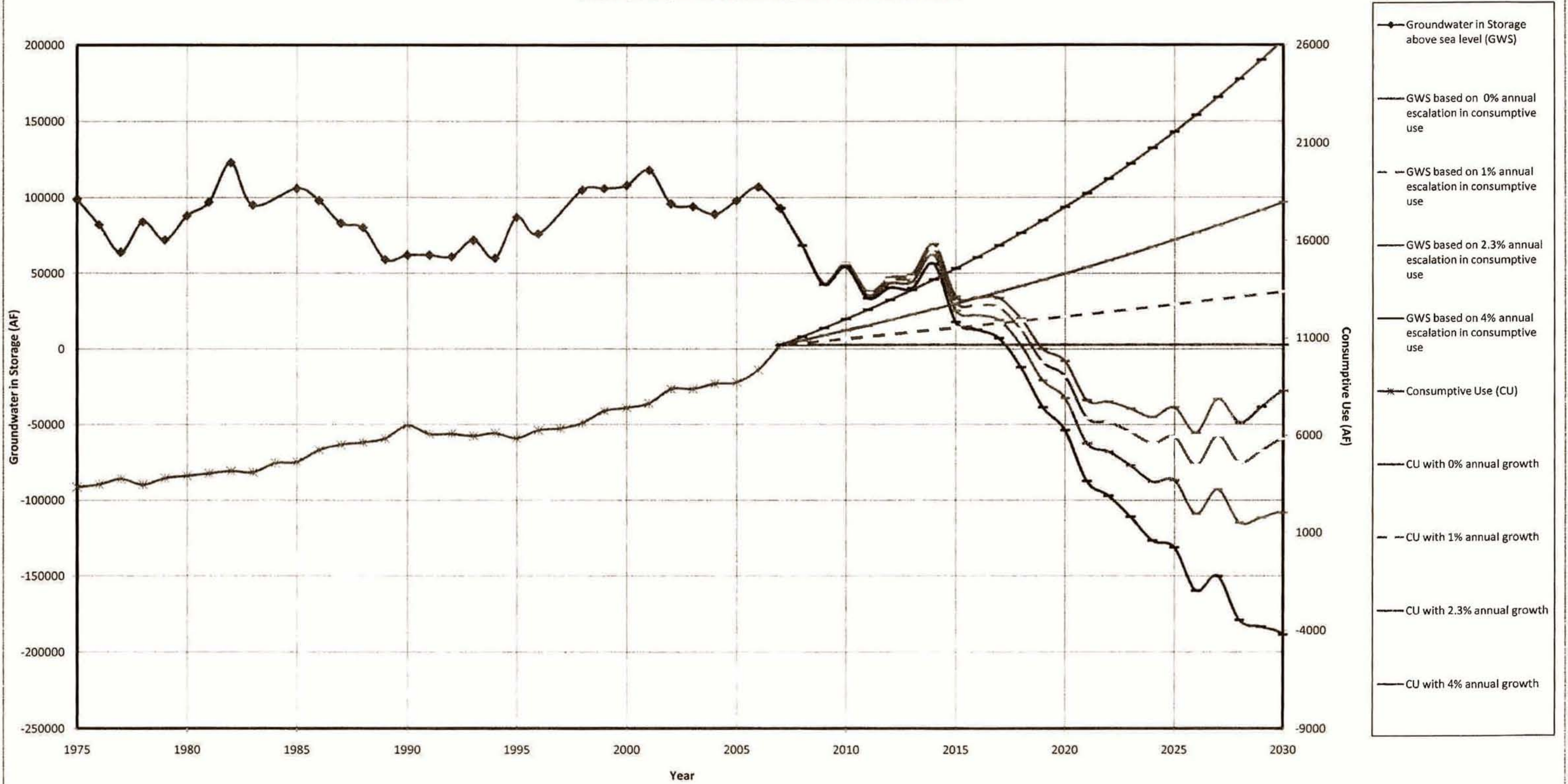
**Water Shortage Conservation Stages**  
**Estimates of Annual Groundwater in Storage 1975 to 2028**  
**Scenario 4 - Wet Hydrologic Condition**

Stage	Groundwater in Storage Criteria	Conservation Goal
1	100,000 to 90,001	
2	90,000 to 80,001	10%
3	80,000 to 70,001	35%
4	less than or equal to 70,000	50%

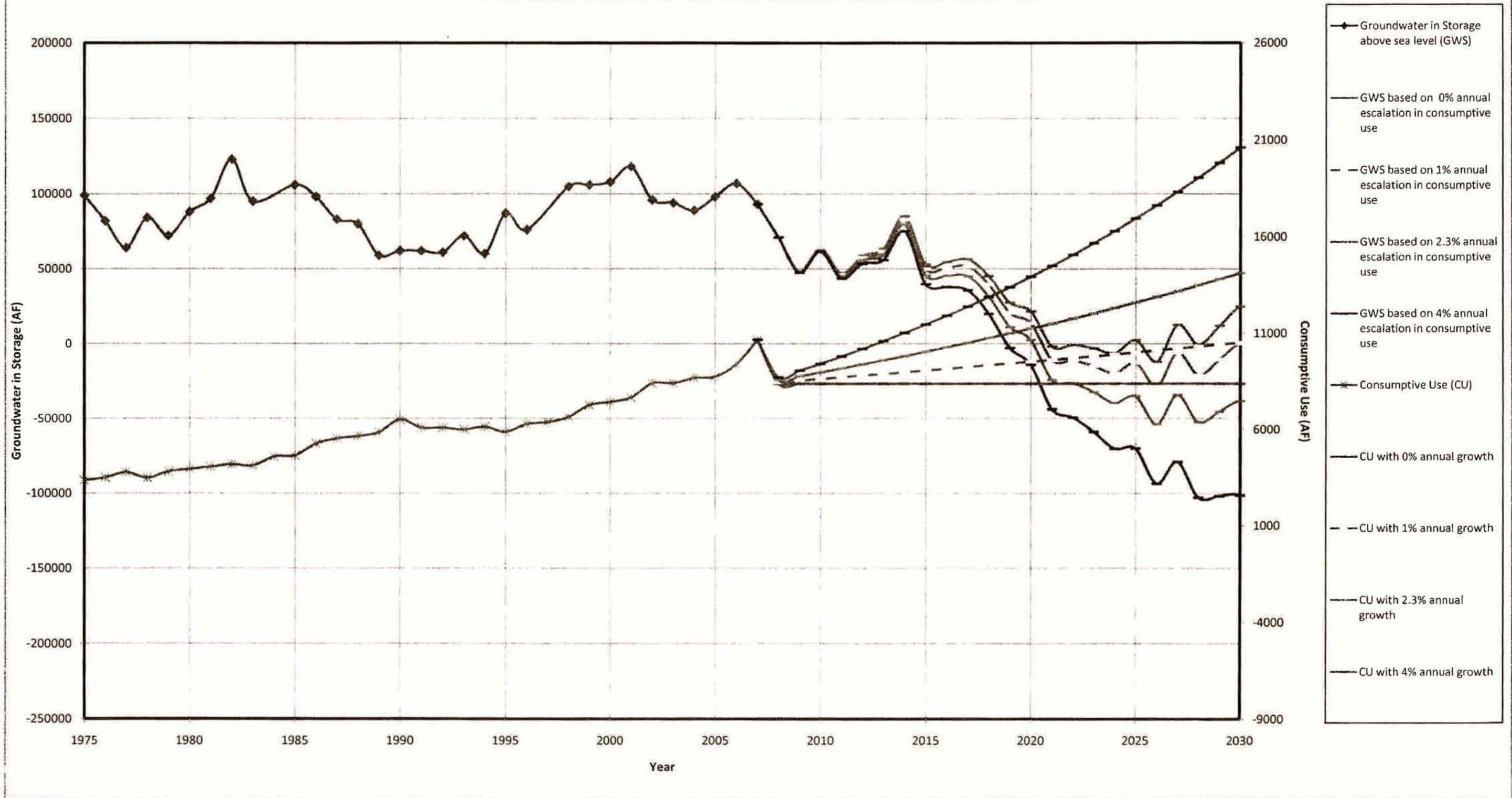
Notes: N/A = not applicable



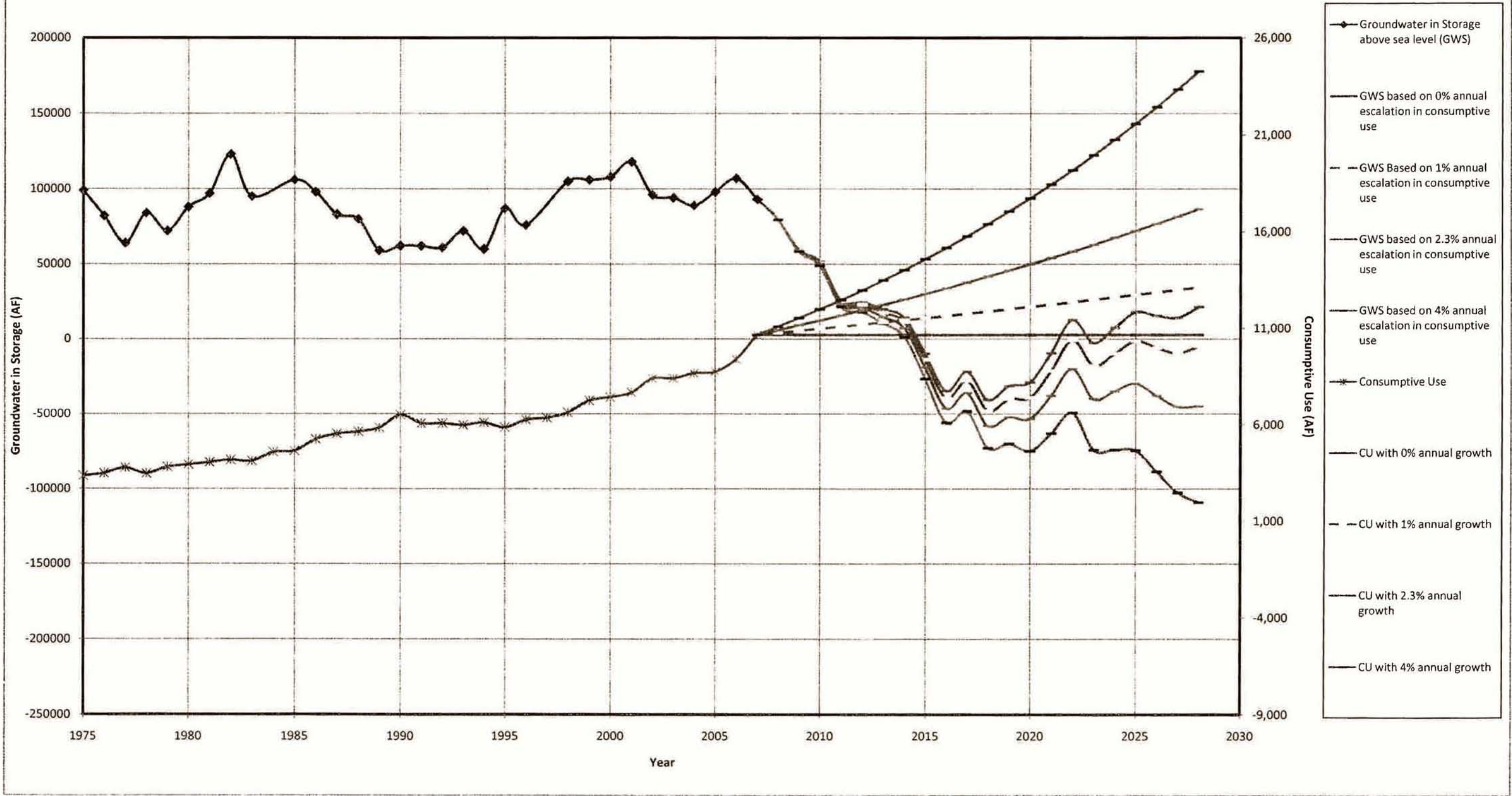
## Groundwater in Storage and Consumptive Use HISTORICAL HYDROLOGIC CONDITIONS



### Groundwater in Storage and Consumptive Use 50% REDUCTION OF URBAN WATER CONSUMPTIVE USE

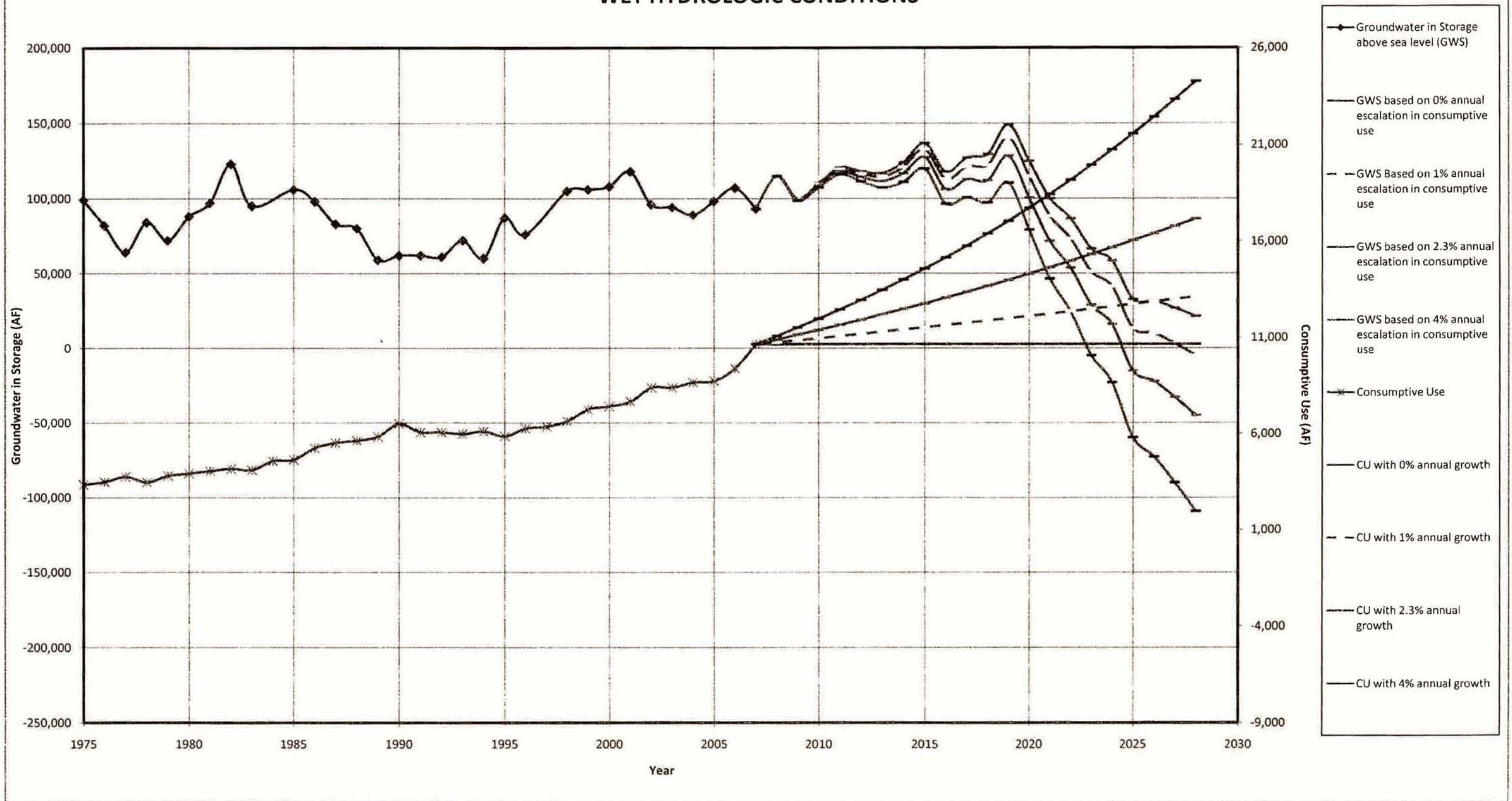


### Groundwater in Storage and Consumptive Use DRY HYDROLOGIC CONDITIONS





### Groundwater in Storage and Consumptive Use WET HYDROLOGIC CONDITIONS







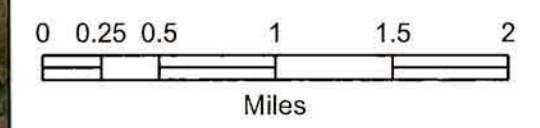
File: Nipomo/2007\_LandUse.mxd

**DRAFT**



## 2007 Nipomo Mesa Land Use Classification

-  Phase III NMMA Boundary
-  Agriculture
-  Urban
-  Native



**NOTES:**  
 Base Map: June 2007 IK Curtis 1ft-res air photo  
 Coordinate System: UTM Zone 10N  
 Horizontal Datum: NAD 83



FIGURE:  
**23**

DATE: 11/20/07 BY: APappas