



El Dorado Irrigation District

DROUGHT
PREPAREDNESS
PLAN

January 2008



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CALDWELL

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017-130868-001

Subject: Drought Preparedness Plan for El Dorado Irrigation District

Dear Mr. Witter and Mr. Hetland:

We are pleased to submit to you this Drought Preparedness Plan (Plan) for the El Dorado Irrigation District. Drought preparedness is an essential element of the long-term water supply planning for El Dorado County. The Brown and Caldwell team has delivered a Plan that presents the actions and procedures for preparing for, identifying, and responding to a drought.

We enjoyed working with you and look forward to your feedback on this important project. Please contact Tess Kretschmann, Lisa Maddaus or myself at (916) 444-0123 to discuss this project report in further detail.

Sincerely,

BROWN AND CALDWELL



Paul Selsky, P.E.
Vice President

PS:ds

DROUGHT PREPAREDNESS PLAN FOR EL DORADO IRRIGATION DISTRICT

January 2008



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LIST OF ACRONYMS

4-Stage Matrix	<i>4-Stage Water Supply Matrix and Water Shortage Response Measures</i>
ac-ft	acre-feet
Ag	agricultural
AMI	Agricultural Metered Irrigation
AR	administrative regulations
BP	Board Policy
C	Celcius
City	City of Placerville
CO ₂	Carbon Dioxide
County	El Dorado County
deg	degree
DICC	Drought Interagency Coordinatin Committee
DAC	Drought Advisory Committee
DCWWTP	Deer Creek Wastewater Treatment Plant
DSR	days supply remaining
DWR	Department of Water Resources
EDCWA	El Dorado County Water Agency
EDHWWTP	El Dorado Hills Wastewater Treatment Plant
EID	El Dorado Irrigation District
ENSO	El Nino Southern Oscillation
F	Fahrenheit
GCM	Global Circulation Model
GDPUD	Georgetown Divide Public Utility District
GFCSD	Grizzly Flats Community Service District
IMS	Irrigation Management System
M&I	Municipal and Industrial
NDSR	normalized days supply remaining
NOAA	National Oceanic & Atmospheric Administration
OES	Office of Emergency Services
Plan	Drought Preparedness Plan
PG&E	Pacific Gas and Electric
precip	precipitation
SEI	Stokholm Environment Institute
SMAC	Strategic Management and Communications
SMUD	Sacramento Municipal Utility District
SRI	supply remaining index
SVM	Shared Vision Model
UARP	Upper American River Project
UFW	Unaccounted-for water
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
UWMP	Urban Water Management Plan
WMP	Water Management Plan

EL DORADO IRRIGATION DISTRICT DROUGHT PREPAREDNESS PLAN

DROUGHT ACTION PLAN

This Drought Action Plan is a summary of drought stages and actions that are described, along with their development, in detail, in the balance of this Drought Preparedness Plan (Plan). This section is meant to be available as a stand-alone resource and reference.

El Dorado Irrigation District (EID) drought stage water supply conditions, objectives, and response actions including water use reduction targets, are summarized in Table 1. The Plan involves an introductory Stage 1 drought response during which all customers are informed of drought and total customer demand reduction is targeted for 15 percent. At Stage 2, water use decisions initially continue to be entrusted to the customer as long as the overall water use reduction goal of up to 30 percent is met; this is a voluntary/honor system approach. If this voluntary phase of Stage 2 fails, then a Stage 2 mandatory phase is initiated. In Stage 3, a strict allotment approach is implemented with a stiff penalty rate and a total demand reduction goal of up to 50 percent. Each of these stages and actions are further described in this section.

Table 1. Drought Preparedness Plan Summary			
Water supply conditions	Drought stage	Objective	Response actions
Normal 0% Total Supply Reduction	Drought Stage Zero - Ongoing Conservation. Water waste prohibition in effect.	Public awareness	Normal actions
Slightly Restricted Water Supplies (below normal) Up to 15% Total Supply Reduction	Drought Stage 1 – Introductory Stage. Voluntary reductions in use	Initiate public awareness of predicted water shortage and encourage conservation	Encourage voluntary measures to decrease “normal” demand up to 15%
Moderately Restricted Water Supplies Up to 30% Total Supply Reduction	Drought Stage 2 – Voluntary Phase for water use reductions and potential subsequent Mandatory Phase with restrictions on use.	Increase public understanding of worsening water supply conditions, encourage voluntary conservation measures, and enforce some mandatory conservation measures	Encourage some voluntary measures and enforce mandatory measures and implement water rationing to decrease “normal” demand up to 30% Drought surcharge enacted (potential in-house trigger and board action)
Severely Restricted Water Supplies Up to 50% Total Supply Reduction	Drought Stage 3 – Mandatory restrictions (severe prohibitions) on use	Ensure that water use is limited to health and safety purposes	Enforce extensive restrictions on water use and implement water rationing to decrease demand up to 50% of “normal” demand

Ongoing Drought Preparedness Plan Implementation Actions

Ongoing Plan implementation actions will be implemented both during periods of non-drought and drought. These activities can be characterized as proactive actions that prepare for drought through monitoring, public outreach, and resource management practices.

Policy and Regulation

1. Review and update Plan every 5 years or as needed based on new supply, operational changes, or change in expected water demand.
2. Enforce water waste prohibition.
3. Continue conservation policies, including water-efficient plumbing retrofits.
4. Continue and advance Irrigation Management System (IMS) program.
5. Review and refine rate stabilization policy relating to drought impacts every 5 years.
6. Understand and comply with legal and regulatory requirements for drought management.
7. Suggest Domestic Irrigation customers have a water conservation plan on file with EID and update this plan every 5 years.
8. Suggest Agricultural Metered Irrigation (AMI) customers not participating in the IMS program to have a water conservation plan on file with EID and update this plan every 5 years.
9. Small Farms must submit a water conservation plan during the account certification to qualify for the Small Farm rate. The plan must be updated every 3 years during the re-certification process.

Monitoring

1. Run Drought Status Supply Remaining Index (SRI) model quarterly to assess drought status with updated demand and supply information. SRI Trigger Plan sequence shown in Figure 1. El Niño Southern Oscillation (ENSO) climate cycle episode is a secondary indicator.
2. Monitor system demands for consistency with SRI model assumptions.

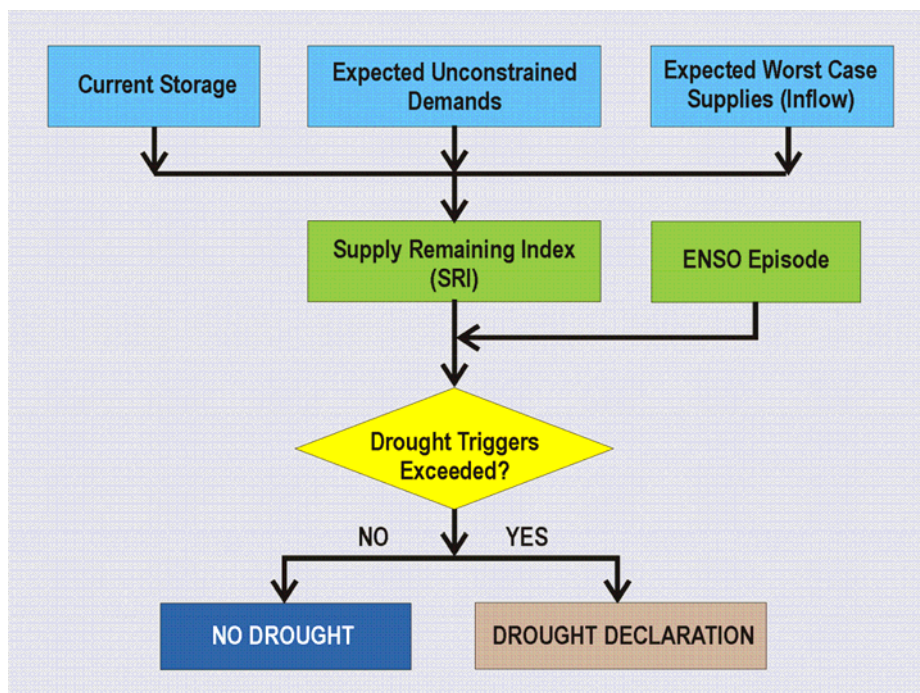


Figure 1. Drought Status SRI Trigger Plan Flow Chart

The EID SRI trigger plan is summarized in Table 2 and described below.

Month	ENSO	SRI	Last month's stage	This month's stage
May	Any	<0.6	0	1
		<=0.75	1,2,3	Last month's stage
June - Sept	Any	<0.10	2	3
	<0.35*	<0.12	0,1,2	2
	<0.35*	<0.12	3	3
Any	Any	>0.75	0,1,2,3	0

* the ENSO average of three previous months must be less than 0.35

- If it's May and SRI is less than 0.6 go to Stage 1 (if in Stage 0); if already in drought and SRI is less than 0.75, stay at the stage from the month before.
- In June through September, if SRI is less than 0.10 and the previous month was in a Stage 2 drought, then go to Stage 3.
- In June through September, if the SRI is less than 0.12 and the average previous three months ENSO is less than 0.35, then go to Stage 2; if the previous month was in Stage 3 drought, stay in Stage 3.
- In all months if SRI is greater than 0.75, there is no drought curtailment. This either continues a period of no drought or ends the drought response of the month before.
- In all other cases, the drought stage this month is the same as the previous month.

Public Outreach

1. Develop and maintain drought awareness and public education materials, tools, and protocol.
2. Continue water efficiency programs including limiting sidewalk washing and car washing without a shutoff nozzle; and fixing leaks within 72 hours.
3. Develop website link for "Drought Stage" information.

Resource Management

1. Maintain interagency coordination annually as shown in Figure 2. Figure 2 depicts the type and frequency of interagency coordination activities that will be pursued by the Drought Interagency Coordination Committee (DICC).
2. Confirm and maintain commitment of Drought Advisory Committee (DAC) members as shown in Figure 3. Figure 3 depicts the suggested interagency organizational structure.
3. Pursue development of potential drought impact avoidance projects.
 - PL101-514 supply
 - Additional water conservation
 - Water loss reduction
 - Groundwater banking
 - White Rock Diversion
 - Sly Park flashboards
 - Alder Creek Reservoir
 - Texas Hill Reservoir
 - Capps Crossing Reservoir
4. Establish and maintain trucking contracts for water hauling (annually).
5. Construct and maintain tap manifolds for emergency water distribution through hydrants.
6. Establish procedure by which residents on wells within EID service area apply for emergency relief.

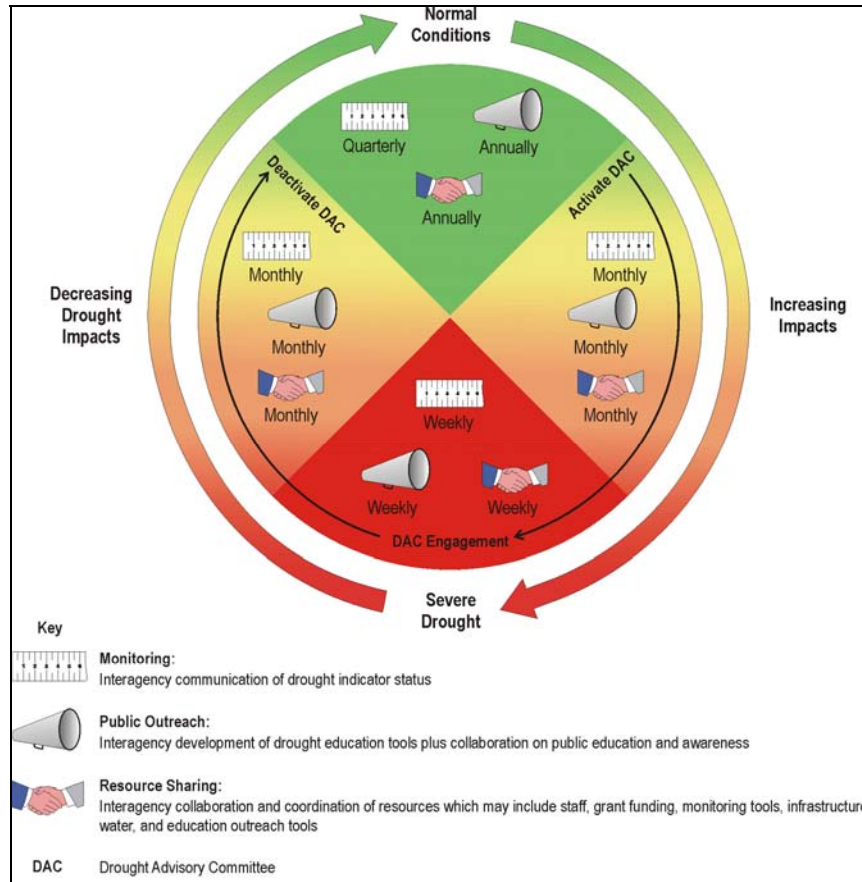


Figure 2. Drought Interagency Coordination Committee (DICC) Activities

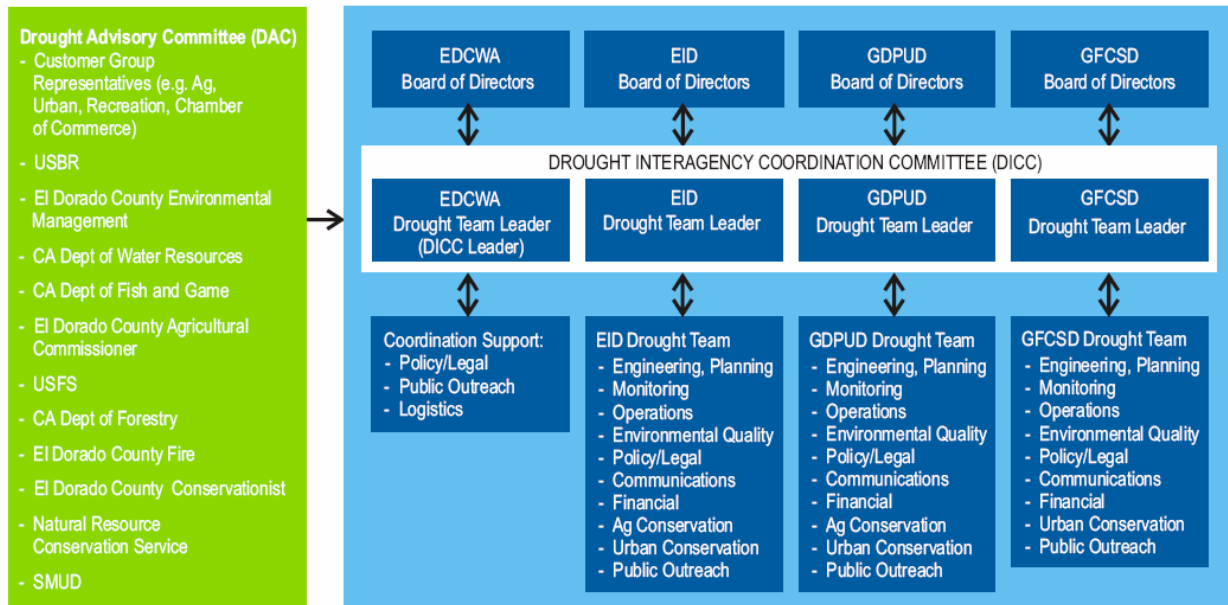


Figure 3. Drought Interagency Organization Structure

Drought Stage 1 Actions

Drought Stage 1 actions are intended to initiate public awareness of water shortages and encourage conservation. Stage 1 actions target up to 15 percent demand reduction through implementation of voluntary measures.

Policy and Regulation

1. Implement Stage 1 water shortage response measures. Customers are suggested to:
 - Apply irrigation water only during the evening and early morning hours (8 PM to 6 AM) to reduce evaporation losses.
 - Inspect all irrigation systems, repair leaks, and adjust spray heads to provide optimum coverage and eliminate avoidable over-spray.
 - Change the minutes of run-time for irrigation valves consistent with fluctuations in weather as determined by evapotranspiration (ET) data, obtained from EID or ET controllers.
 - Reduce minutes of run-time for each irrigation valve if water run-off (gutter flooding) is occurring.
 - Utilize water conservation incentive, rebate, and giveaway programs to replace high water-using plumbing fixtures and appliances with water efficient models.
 - Take advantage of the free information available from EID on how to use water efficiently, read a water meter, repair leaks, and irrigate efficiently.
 - Do not refill a swimming pool that had been drained.
 - Fix leaks.
 - Wash vehicles from a bucket. Use a hose equipped with a shutoff nozzle for a quick rinse (commercial car washes exempted).
2. Drought Team Leader provides monthly updates on drought status to EID management.
3. EID management provides monthly updates to Board.

Monitoring

1. Assess current drought stage monthly using Drought Status SRI Model with current demand and supply information.
2. Consider potential future hydrologic conditions in Drought Status SRI Model.
3. Monitor water demand monthly to assess water savings accomplished.

Public Outreach

1. Initiate community-oriented drought awareness with focus on community water use reduction goals and range of voluntary steps to accomplish savings.
2. Reacquaint customers with EID's Water Waste Prohibitions and introduce Stage 1 recommended water shortage response measures.
3. Provide monthly updates to public on current drought stage using the Drought Status SRI Model dashboard.
4. Provide monthly updates to public on community demand response status.

Resource Management

1. Monthly DICC meetings.
2. Confirm commitment by DAC members.

Drought Stage 2 Actions

Drought Stage 2 action items are intended to increase public understanding of worsening water supply conditions, encourage community-oriented voluntary conservation measures, enforce some mandatory conservation measures, and implement water use reduction measures to decrease “normal” demand by up to 30 percent. If the Stage 2 Voluntary Phase approach is not effective or becomes unfair to too many customers, then the Stage 2 Mandatory Phase will be implemented. Stage 2 activities include a continuation of activities described previously under Stage 1 and Ongoing actions. The achievement of the water use reduction goal is measured by overall performance of the entire customer population, based on EID production meters. It is important to note that user category demand reduction goals are not by individual customer, but are the goal for the customer category.

Policy and Regulation

1. Implement Stage 2 water shortage response measures, including a continuation of Stage 1 activities. The following are recommendations/restrictions to potable water customers.

- Indoor residential use (excluding irrigation only use) is targeted to approximately 70 percent of the amount used when no water use reduction is required.
- Any “irrigation only use” is targeted to approximately 55 percent of the amount used in the base year. (Higher demand reductions here to save water use in other areas that would force job cuts).
- Commercial, industrial and institutional use is targeted to approximately 80 percent of the amount used by the customer in base year.
- Restricted use of water from a fire hydrant - use limited to fighting fires, human consumption (hauling from designated sites allowed by persons whose wells have gone dry with EID Board approval), stock water, essential water quality flushing, and toxic clean-up purposes.
- No watering of any existing turf grass, ornamental plants, garden, landscaped area, tree, shrub or other plant except by hand held hose or container, drip irrigation system, or other approved EID conservation practice.
- No watering of new turf grass or replacement turf grass.
- No initial filling of any swimming pool.
- No automatic serving of drinking water at dining establishments except with patron request.

Restrictions for agricultural customers are as follows:

- Domestic Irrigation and AMI customers not participating in the IMS program, but have a water conservation plan on file with EID, will reduce water use by up to 15% of the base year or face financial penalty.
 - Domestic Irrigation and AMI customers not participating in the IMS program and do not have a water conservation plan on file with EID will reduce water use by up to 25% of the base year or face financial penalty.
 - Small Farm customers will reduce water use by up to 15% of the base year or face financial penalty.
 - New commercial crop plantings that are already in the ground will receive the full amount of water needed to ensure the survival of the crop.
 - New crops not already in the ground will not be irrigated using EID supplied water.
2. Drought Team Leader provides weekly updates on drought status to EID management.
3. EID management provides at least monthly updates to Board.

4. EID management provides the Board of Directors with an assessment of the need to enact a drought surcharge.

Monitoring

1. Assess current drought stage twice monthly using Drought Status SRI Model with current demand and supply information.
2. Consider potential future hydrologic conditions in Drought Status SRI Model.
3. Monitor water demand weekly to assess water savings accomplished under voluntary measuring.

Public Outreach

1. Accelerate community-oriented drought awareness with focus on community water use reduction goal and range of voluntary steps and mandatory requirements to accomplish savings.
2. Reinforce with customers the EID Water Waste Prohibitions and Stage 2 voluntary and mandatory recommended water shortage response measures.
3. Customers are informed that individual meter records will not be audited or fees levied if overall water use reduction goal is achieved.
4. Customers who can conserve more are strongly encouraged to help customers who would incur economic hardship if they met the water use reduction goal.
5. Provide weekly updates to public on current drought stage.
6. Provide weekly updates to public on community demand response status.

Resource Management

1. Weekly DICC meetings to coordinate on monitoring, public outreach, current status, and opportunities for resource sharing.
2. Enact participation by DAC members.

Drought Stage 3 Actions

The objective of Drought Stage 3 actions are to reduce water demand by up to 50 percent through effective and consistent public outreach, enforce extensive restrictions on water use, and implement water rationing. Protection of water supply for public health and safety purposes is the primary objective during Stage 3 drought conditions.

Policy and Regulation

1. Implement Stage 3 water shortage response measures which includes enforcing Stage 1 and Stage 2 recommended water shortage response measures. The following are restrictions to potable water customers.
 - Residential meters serving single family detached homes are granted a 68 gallons per day per person allotment.
 - Residential meters, serving multiple units are granted up to 50 percent of the amount used by the customer during the corresponding billing period in the base year.
 - Irrigation only meters: 35 percent of the amount used by the customer during the corresponding billing period in the base year.
 - Meters serving any non-residential use: 60 percent of the amount used by the customer during the corresponding billing period in the base year. (Note: Vital healthcare and public safety use is set at 65 percent).

Agricultural customers will be affected as follows:

- Domestic Irrigation and AMI customers not participating in the IMS program, but who have a water conservation plan on file with EID, will reduce water use by 30% of the base year or face financial penalty.
 - Domestic Irrigation and AMI customers not participating in the IMS program and who do not have a water conservation plan on file with EID will reduce water use by 50% of the base year or face financial penalty.
 - Small Farm customers will reduce water use by 30% of the base year or face financial penalty.
 - IMS Agricultural customers must utilize IMS program or surcharge enacted.
2. Drought Team Leader provides weekly updates on drought status to EID management.
 3. EID management provides the Board of Directors with an assessment of the need to enact a drought surcharge.
 4. EID management to provide recommendation to the Board of Directors on increasing the frequency on residential meter reading to monthly for accelerated assessment of demand reduction.

Monitoring

1. Assess current drought stage monthly using Drought Status SRI Model with current demand and supply information.
2. Consider potential future hydrologic conditions in Drought Status SRI Model.
3. Monitor water demand weekly to assess water savings accomplished.

Public Outreach

1. Accelerate community-oriented drought awareness with focus on community water use reduction goals, range of voluntary steps, and mandatory requirements to accomplish savings.
2. Reinforce with customers the EID Water Waste Prohibitions and Stage 3 mandatory water shortage response measures.
3. Provide weekly updates to public on current drought stage.
4. Provide weekly updates to public on community demand response status.
5. Continue with procedure for customer reporting of water waste.

Resource Management

1. Weekly DICC meetings to coordinate on monitoring, public outreach, current status, and opportunities for resource sharing.
2. Continue participation by DAC members.
3. Coordinate and schedule water hauling as needed.
4. Implement and monitor tap manifolds for emergency water distribution through hydrants as needed.

EL DORADO IRRIGATION DISTRICT DROUGHT PREPAREDNESS PLAN

1. INTRODUCTION

This document presents the Drought Preparedness Plan (Plan) for the El Dorado Irrigation District (EID). This Plan presents the actions and procedures for preparing for, identifying, and responding to a drought. The objective of the Plan is to help EID preserve essential public services and minimize the effects of a water shortage on public health and safety, economic activity, environmental resources, and individual lifestyle.

Drought occurs when precipitation over a season or longer is insufficient to meet the demands of human activities and the environment, resulting in water shortage conditions. Drought preparedness is an essential element of water supply planning.

This Plan represents the results of the second phase of a two phase drought planning process. The first phase consisted of four public workshops, presentations by experts, and a multi-faceted drought analysis. This section presents the Plan's needs and objectives, planning overview, drought history, climate change considerations (including the Water Evaluation and Planning System Analysis), EID water supply and demand, EID drought management policy, stakeholder involvement, drought planning approach, and plan content.

1.1 Plan Need and Objectives

Residents of El Dorado County (County) depend on surface water from the watersheds of the Sierra Nevada mountain range for their water supply. The Sierra Nevada snowpack serves as natural storage for much of the region's annual precipitation. These watersheds experience large variations in annual precipitation and resulting water supply. This area has experienced significant droughts in the past. The possibility of climate change may increase the frequency and severity of droughts. The population growth in the County and the resulting increase in water demand will amplify the severity of drought impacts. While the occurrence of droughts cannot be controlled, droughts and their impacts can be anticipated and planned for. A Drought Preparedness Plan is needed to guide EID to accomplish its mission of providing high quality water services in an environmentally and fiscally responsible manner during drought conditions.

This Plan is intended to satisfy multiple objectives that consist of:

- Defining a common understanding of drought susceptibility, monitoring, communication, response, and opportunities for drought avoidance among each of the County west slope water agencies.
- Updating EID drought planning to incorporate new water supplies, most recent water demand projections, expanding water conservation efforts, new methods of public outreach, and potential impacts of climate change.
- Defining improved drought indicators and trigger levels that declare droughts accurately and early enough.
- Defining water demand curtailments that can reasonably be accomplished in drought conditions, are financially sustainable, administratively appropriate, user-friendly, and will perform well for all customers and stakeholders.
- Providing a roadmap for Plan implementation that focuses EID's continuing efforts on activities that will monitor for the onset of drought, minimize drought impact on customers and EID, and implement projects and other measures to reduce the need to declare drought.

This Drought Preparedness Plan reflects EID advances in drought planning since the *4-Stage Water Supply Matrix and Water Shortage Response Measures* was adopted by the Board of Directors in June 1995. The EID water supply portfolio has expanded considerably since 1995, with water sources serving various areas within EID. The expanded water supply portfolio improves reliability and redundancy of supplies, however, limitations on the ability to convey water within EID may result in some areas being impacted sooner by reduced supply.

1.2 El Dorado County Drought Planning Overview

In 2004, because of the need and value of drought planning and preparedness, the El Dorado County Water Agency (EDCWA), EID, Grizzly Flats Community Service District (GFCSD), and Georgetown Divide Public Utility District (GDPUD) initiated a drought planning process. The objective was to address the needs of residents on the western slope of the County during drought conditions.

The drought planning process has been conducted in two phases in a collaborative approach among drought plan stakeholders centered on a “shared vision” approach to drought analysis and planning. This approach helped the County water community develop an understanding of the drought susceptibility of each agency and the actions that can be pursued individually and as a community to reduce or mitigate drought impact. The shared vision process is highlighted by the use of a user-friendly, transparent Shared Vision Model (SVM) that stakeholders use to develop an effective and equitable drought management program. A copy of the most recent SVM can be found on a CD in Appendix A. Phase 1 drought planning included the analysis of drought impacts in EID and the western slope of the County, with focus on the potential to reduce drought impacts through demand management and supply augmentation actions.



The *El Dorado County Western Slope Drought Analysis – Phase 1 Report* (Brown and Caldwell, 2006) describes the development of the SVM and the results of the drought analysis. At the conclusion of Phase 1, drought stakeholders understood the current water supply reliability during drought for each of the County’s three western slope water purveyors based on current policy, water rights, and infrastructure. Additionally, drought stakeholders understood the needs, opportunities, and constraints facing each agency in the future as they implement policies, programs, and projects to mitigate or avoid drought impacts.



Jenkinson Lake/Sly Park Reservoir 1977
Picture courtesy of EID

This Phase 2 drought planning effort focused on the development of individual drought plans for EID, EDCWA, GFCSD, and GDPUD. Drought plans include actions to improve drought management within the service area of each water agency, and also include actions from the shared vision process that encourage collaboration across the County western slope community to gain efficiency in drought monitoring, provide water for essential public health and safety, synthesize outreach activities, and integrate drought avoidance projects at the County level. Phase 2 also includes updates and improvements to the SVM based on stakeholder comment and requested additions.

1.3 Drought History

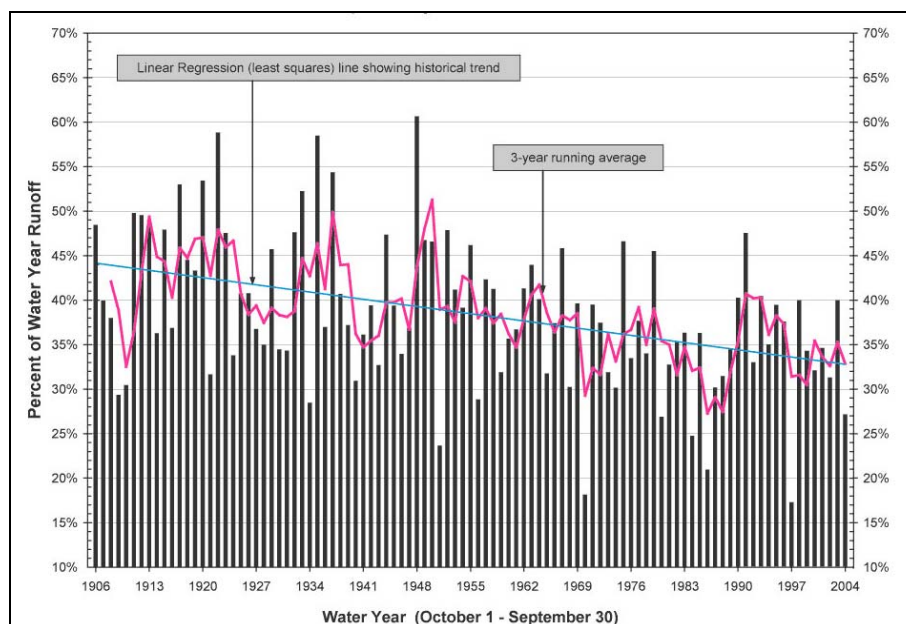
Formally organized in 1925, EID has recently experienced drought periods in 1976-77 and 1987-92. Droughts also occurred in 1924, 1931-1934, 1939, and 1959-61. The paleoclimatic record dating back several centuries, indicates the occurrence of previous droughts of significantly greater severity and duration than these recent drought events. During the 1976-77 drought, the annual flow in the South Fork of the American River was 10 percent of the 1923-2003 average.

Although no enforced conservation measures were adopted by the EID Board of Directors for the 1988 year, EID was successful in promoting and obtaining voluntary cooperation from its customers. The result was an overall 30 percent reduction in customer water use over 1986 as reported in EID drought status reports. However, similar reductions in water use during future drought may be more challenging as the EID customer base grows, water demands increase, and ongoing programs continue to improve water use efficiency. Additional detail of past droughts is provided in Section 2 of the Phase 1 Report.

1.4 Climate Change

Future climate change, caused by both naturally recurring cyclic patterns and possible human activities, may impact the intensity and duration of future droughts. As a result, future droughts may exhibit different characteristics than those observed during recent droughts. It is important to consider and plan for climate change because of the adverse effects of temperature and precipitation changes.

As an example, predictions are that average temperatures during the next 100 years will increase by approximately two degrees Celsius. Increasing average temperatures, resulting in earlier and heavier snowmelt runoff, will have greater affect on water purveyors reliant on surface water as compared with those reliant on groundwater. An existing trend of accelerated spring snowmelt and associated runoff in northern California is evidenced by late season (April – July) runoff in the Sacramento River as a percentage of total runoff for each year from 1906 to 2004 depicted in Figure 1-1.



Source: California Water Plan Update 2005 Volume 4 – Reference Guide

Figure 1-1. Sacramento River (April – July) Runoff in Percent of Water Year Runoff

Late season runoff constituted 44 percent of total runoff in the early 1900s, decreasing to 33 percent by the early 2000s. Melted Sierra Nevada mountain snowpack is the source for the majority of late season runoff for EID. This snowpack is relied upon by EID for measured release and late season water storage. Further development of surface water storage would reduce the impact of earlier snowpack runoff on EID supplies.

EID recognizes the importance and potential implications of climate change to EID and its customers. Development of the SVM during Phase 1 includes four potential climate change scenarios that allow for an assessment of future supply reliability and potential shortages under changed climate conditions.

EID also recognizes that the SVM rests upon an assumption that is commonly invoked to carry out long-range water management plans, namely that the historic observed pattern of flow in rivers and streams is a good representation of the pattern that will be observed in the future. The technical term for this assumption is that the hydrology is stationary. Climate change research, which is essentially an argument that the future climate will be different than the one experienced in the past, raises the specter that this fundamental tenet of water planning, hydrologic stationarity, may not provide a solid foundation for policy setting and decision making. As it is never a good idea to reject standard practice until a suitable replacement practice has been developed, Stockholm Environment Institute (SEI), an organization active in climate change research, was asked to begin exploring the issue of climate change and drought planning as a supplement to the overall Drought Preparedness Plan.

1.5 Water Evaluation and Planning System Analysis

This section summarizes the report prepared by the SEI, as a supplement to this Drought Preparedness Plan in order to begin to examine in greater detail how climate change may impact the County and how water managers can effectively adapt. The focus of the activity was the portion of the County that is covered by the EID service area. In developing this supplement, SEI sought to build upon the work that was done in developing the SVM that supported the Plan, and then to add the element of future climate change to the analysis. Table 1-1 compares the SVM to the application of the Water Evaluation and Planning (WEAP) system that has been developed by SEI to support water sector climate change impact and adaptation analysis. The major difference is that while the SVM uses the hydrology from the historic 1922-2003 period as input, the WEAP model uses a range of possible scenarios about the future climate in the period up until 2030, and the associated hydrologic regimes, as model input.

Table 1-1. Using the SVM as a Point of Departure for an Application of the WEAP System

Model Attribute	Shared Vision Model	WEAP Application
Installed Infrastructure	Current system	Current System
System Operations	Current logic	Current logic
Regulatory Regime	Existing regulations	Existing regulations
Time-Step	Monthly	Weekly
Time Period	1922-2003	2000-2030
Demands	Fixed 2030 demand	Grows progressively from 2000 to 2030
Hydrology/Reservoir Inflows	Extracted from the historic record	Generated from future climate scenarios
Water Year Classification	Input according to historic sequence	Calculated from future climate scenarios
ENSO Sequence	Input according to historic sequence	Assumed to repeat the worst 30 year period from the historic record
Drought Triggers	Adjusted to achieve a target level of reliability under 2030 demand and the historic hydrology	Fixed so that they could be tested against future climatic and hydrologic conditions
Drought Actions	Adjusted to achieve a target level of reliability under 2030 demand and the historic hydrology	Fixed so that they could be tested against future climatic and hydrologic conditions

Additionally, WEAP was used to investigate the performance of the triggers and actions developed by the SVM in the face of future hydrologic patterns that diverge from past observations.

One critical component of this analysis is the development of plausible future climate and hydrology scenarios. Computer models of the future climate on Earth, commonly referred to as General Circulation Models or GCMs, simulate changes in the climate of a region such as Northern California under a range of assumptions about how quickly greenhouse gases continue to accumulate in the atmosphere. If one assumes that the rate of CO₂ emissions does not decrease appreciably in the coming decades, then the models anticipate approximately a 2°C (3.6°F) increase in average winter (Dec. through Feb.) temperatures by mid-century. As is shown in Figure 1-2, there is some uncertainty among the 21 commonly used GCMs, but the most common expectation is a roughly 2°C warming.

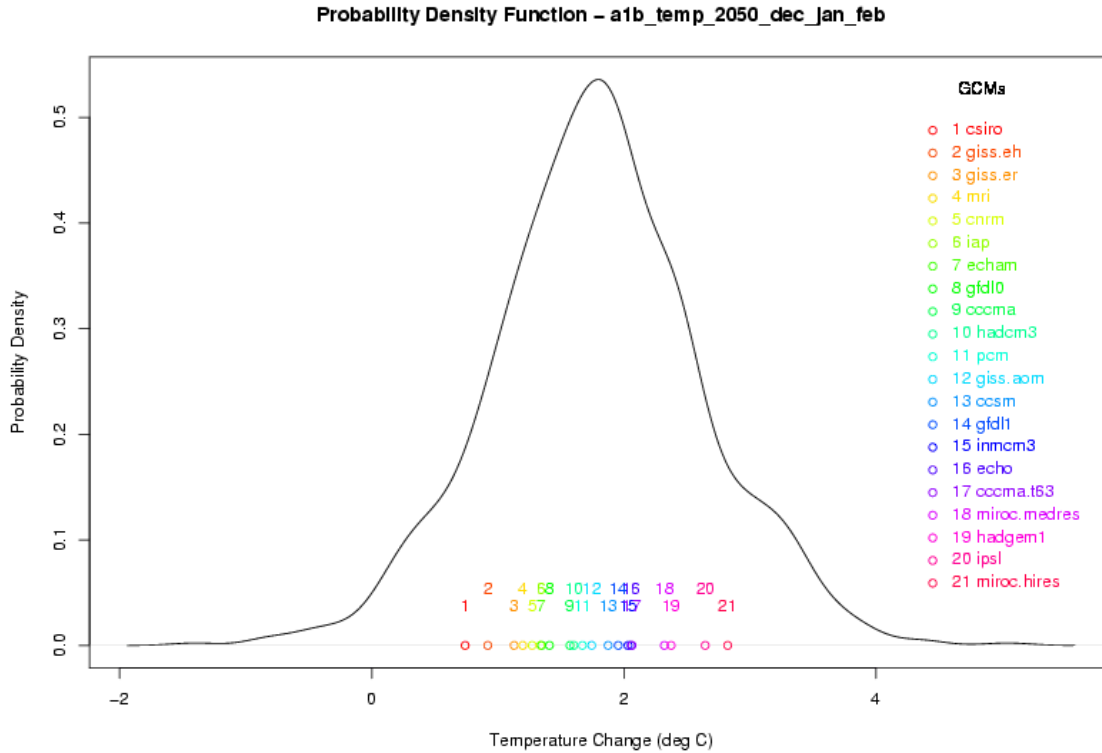


Figure 1-2. Probability of Mid-Century Winter Temperature Increases in Northern California Based on the Output of Commonly Used GCMs. Run under High Greenhouse Gas Emission Scenarios.

While there is some uncertainty among the models as to the extent of future warming, there is at least a consensus that the climate will be warmer overall. When it comes to future expectations about precipitation, the models are even more ambiguous, some predicting that Northern California will be slightly wetter under future climate regimes, others predicting that it will be slightly drier. The central expectation of these models though, as shown in Figure 1-3, is that the amount of winter precipitation in the region, if one assumes that global greenhouse gases emission continue apace in the coming decades, will remain largely unchanged. Care should be taken, however, not to conclude that this means that water managers in the region will be immune to the potential affects of climate change, as the expected increase in temperature will mean that more of the future winter precipitation is likely to fall as rain rather than snow. This in turn will decrease the amount of snow accumulation in the watersheds which provide the water supply for El Dorado County. In addition, warmer spring temperatures will mean that the snow that does accumulate will melt away earlier. Adapting to the impact of all of these changes will challenge water managers.

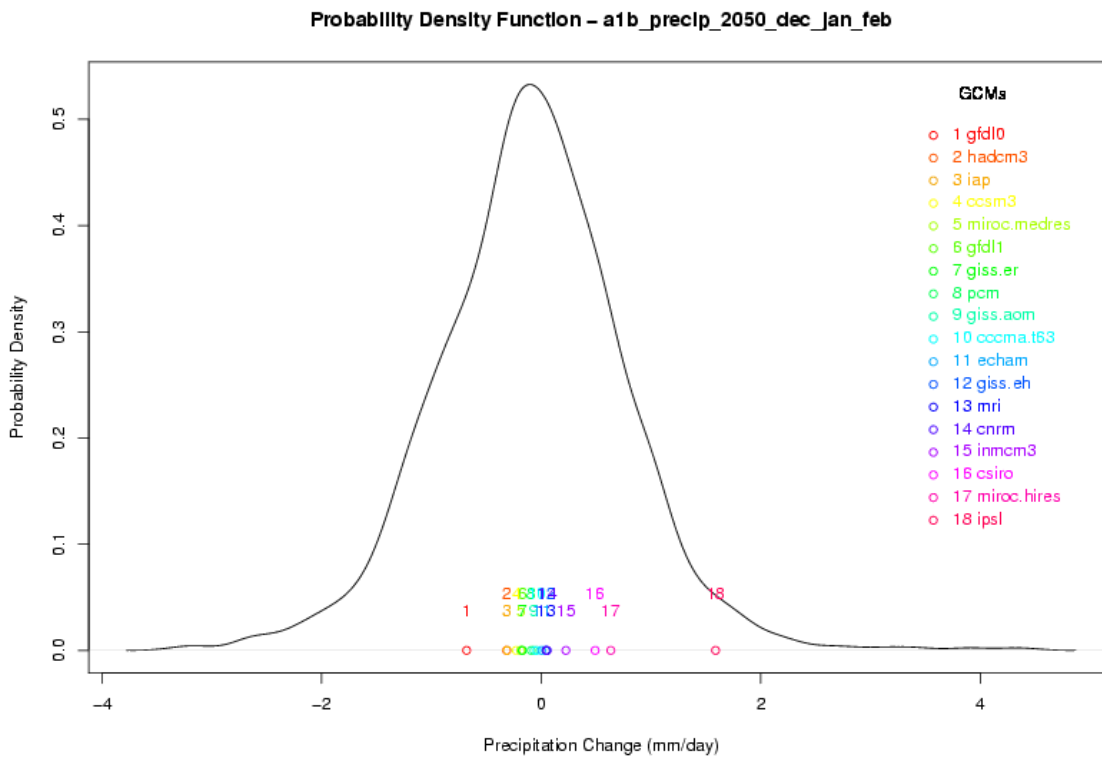
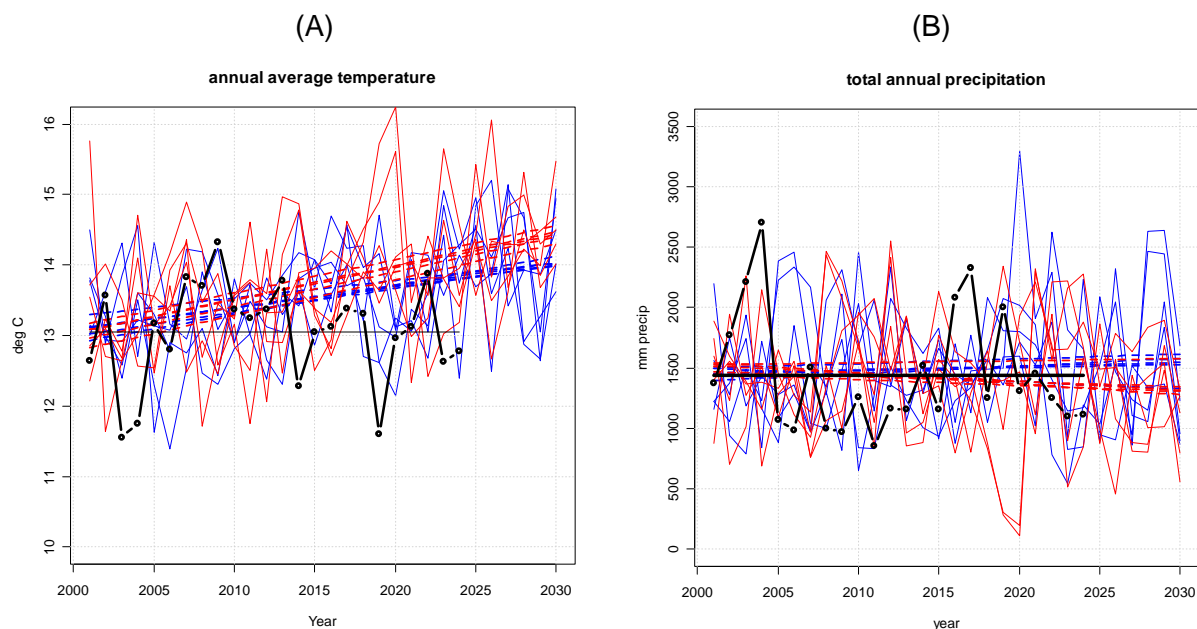


Figure 1-3. Probability of Mid-Century Winter Precipitation Changes in Northern California Based on the Output of Commonly Used GCMs. Run under High Greenhouse Gas Emission Scenarios.

While Figures 1-2 and 1-3 provide some general insights about climate change over Northern California, they do not provide information on the specific weather patterns that water managers in El Dorado County will experience. The process of translating the general inferences from GCMs to local weather information is called downscaling and there are several approaches that are used, each of which has its advantages and disadvantages and its own communities of promoters and detractors. The approach used by SEI for this study involves the generations of a large set, or ensemble, of future climate scenarios which when viewed together will have a statistic profile that corresponds to the probability distributions shown in Figures 1 and 2.

Using this method, a set of future climate scenarios was developed that could be used as input to the WEAP application of the EID system. These are shown in Figure 1-4. In this figure the red time series correspond to scenarios that fall on the hotter and drier side of the future expected values (20°C winter warming, no real change winter precipitation). The blue time series are those that fall on the cooler and wetter side of this central expectation. The black curves represent the conditions observed over the past 25 years. When considered together, these scenarios reflect the overall expectation of what the climate in Northern California might be like in the future if the rate of greenhouse gas emissions does not decrease in the coming decades.



NOTE: The **black** lines are historic regional average temperature (A); and total annual precipitation (B) with trend lines.
 The **red** lines are drier and warmer traces with trend lines.
 The **blue** lines are slightly wetter and not as warm traces with trend lines.

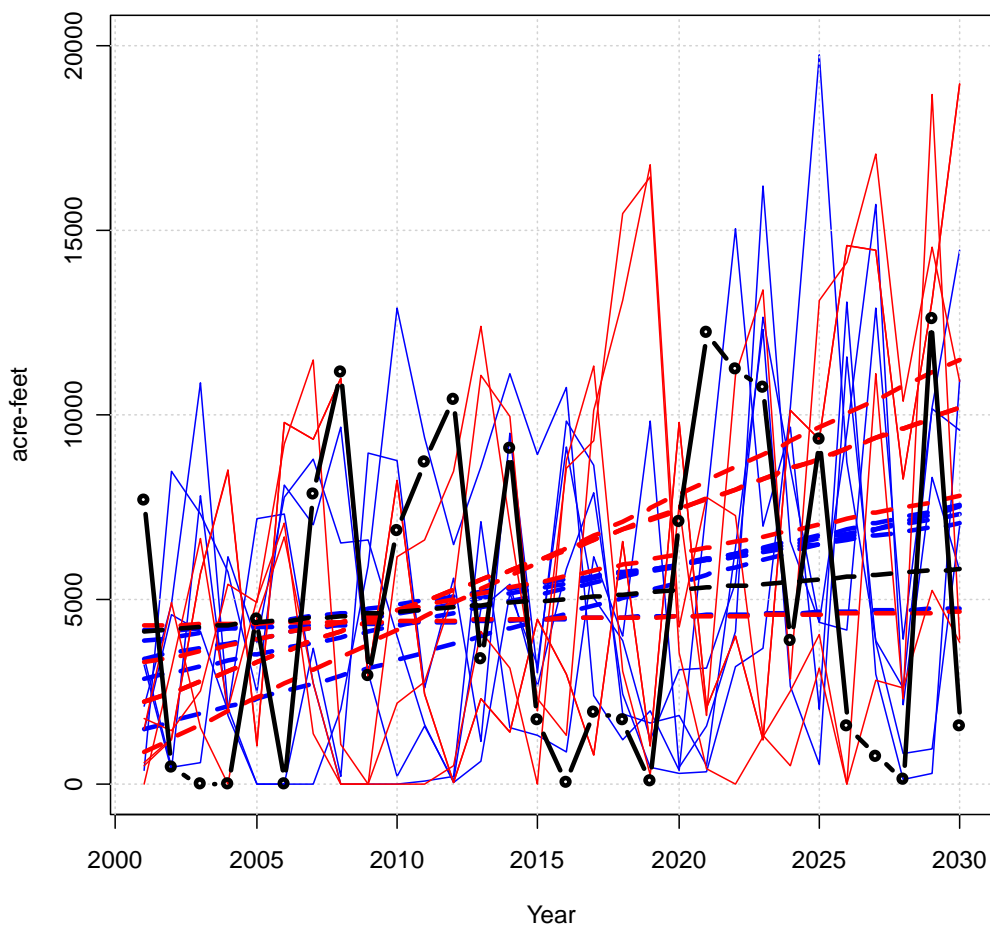
Figure 1-4. Annual Summary Statistics of Possible Future Temperature (A) and Precipitation (B) Scenarios for the Watersheds in the El Dorado County Service Area

Using these climate scenarios, it is now possible to evaluate how the drought triggers and actions developed by the SVM that assumed climate and hydrology would remain stationary in the coming decades, will perform under this range of plausible future climate scenarios developed for use in WEAP.

The current triggers are based on 2030 levels of demand and historic hydrology, to assure that EID will not fail to deliver water to its customers. Stated another way, the proposed triggers and demand cutback actions would allow EID to deliver what it says it can deliver with 100% reliability. However, when exposed to the range of plausible climate scenarios summarized in Figure 1-4, and the hydrologic patterns which result from the climate time series, there are times when EID fails to either supply the amount of water that its customers expect under the fluctuating drought stage, or to meet the instream flow obligations it has agreed to in recent regulatory proceedings, depending on which use is given priority. Given that the overall level of demand in the system is over ten times larger as these potential shortfalls, one conclusion can be that the potential problems caused by climate change will not be a total calamity. Still, the regular failure to meet the stated standard of the proposed drought triggers and actions under a range of plausible climate scenarios should not be ignored.

In the evolution of climate change impact assessment and adaptation planning, it is premature to use results such as those shown in Figure 1-5 as the sole basis for policy setting and decision making. The SVM and its deployment using assumptions accepted in the current practice of water resources planning should not be discounted. Instead, the results in Figure 1-5 should serve to remind decision makers in the County that plausible future conditions associated with climate change expose all future plans and decisions to a level of vulnerability and risk that should be considered as part of rational policy setting. As such, collaboration between EID and SEI will continue in the future under a competitive grant awarded by the National Oceanic and Atmospheric Administration (NOAA) Sectoral Applications Research Program (SARP). In order to

better characterize the uncertainties and risks associated with climate change impacts in the County, this grant will enable decision-makers to reasonably consider these risks in setting policy. A draft report of WEAP's physically-based approach to drought planning and climate change, including scenario analyses and evaluations, can be found in Appendix B.



NOTE: The **black** plot and trend line are the future demands with historic data.
 The **red** lines are drier and warmer traces with trend lines
 The **blue** lines are slightly wetter and not as warm traces with trend lines.

Figure 1-5. Overall Shortfalls Relative to Unmet Demand and/or Unsatisfied Instream Flow Requirements Under a Range of Future Climate Scenarios Based on the Proposed Drought Triggers and Actions

1.6 EID Water Supply and Demand

The following subsections provide a brief summary of EID water supply and demand. Understanding the flexibility and constraints associated with each source of water supply and demand is of primary importance when considering approaches to monitor and mitigate drought. Water supplies and demands were considered during drought plan development, both for current conditions and future conditions extending to year 2030. The SVM incorporates the current and future conditions of EID water supply and demand as represented in the following subsections.

1.6.1 Water Supplies

The following is a general description of EID's primary water supply sources. The approximate location of each source is shown in Figure 1-6. Details regarding specific diversion rates, storage amounts, and other water information can be found in the EID's Draft Water Supply Master Plan (EID, 2001).

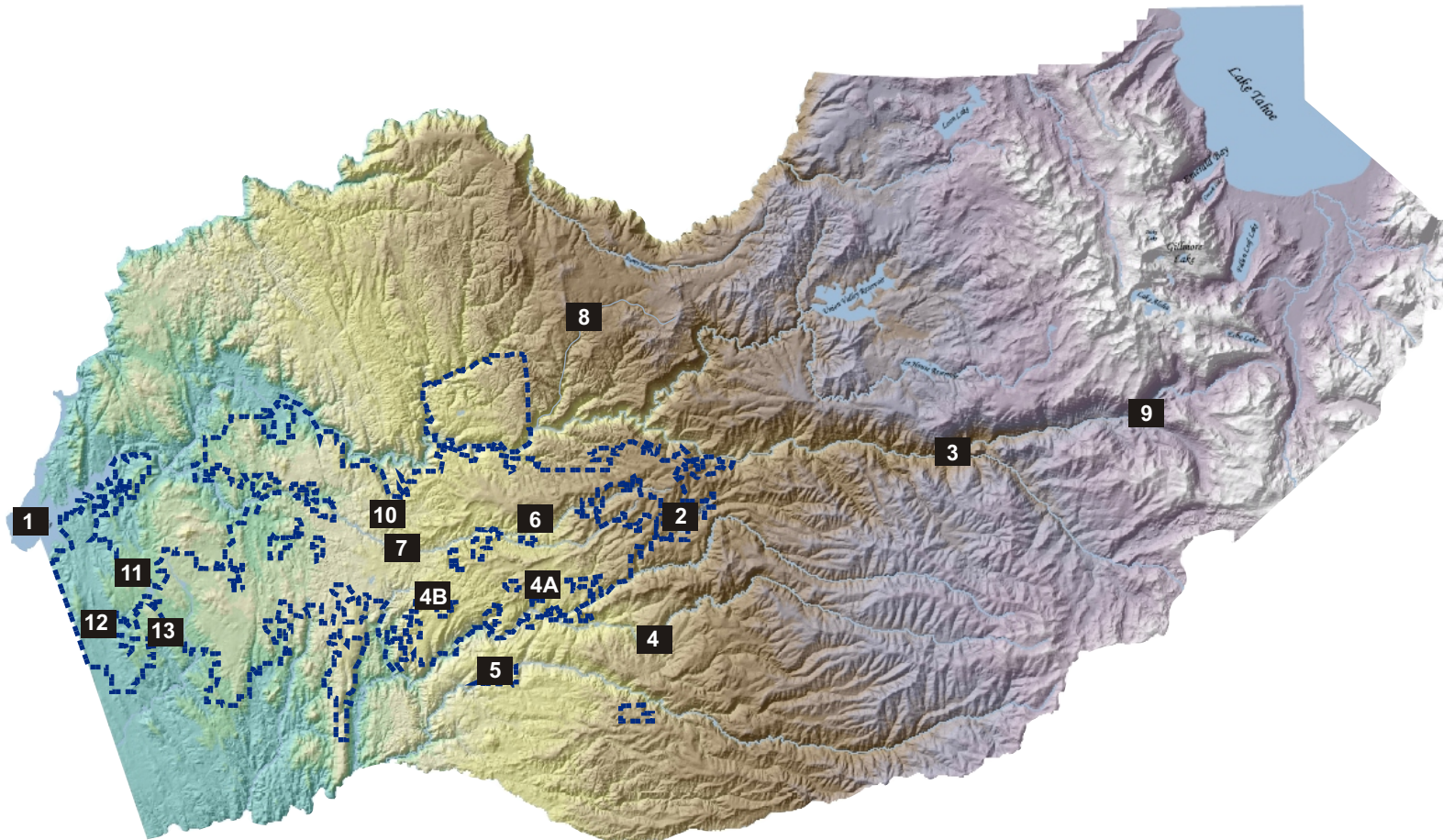
Sly Park Dam and Jenkinson Lake is the main storage project in EID. Jenkinson Lake receives flow from Sly Park, Hazel, and Camp Creeks, all of which are tributary to the North Fork of the Cosumnes River. This reservoir provides about a third the total water supply to EID.

Project 184 Forebay is a surface water supply from EID's facilities upstream on the South Fork of the American River in the El Dorado Project (FERC Project 184). Since the full entitlement can be provided in all years including the most severe historic single dry year 1977, this source of water is considered assured, and not subject to shortage from hydrologic droughts (Brown and Caldwell, 2005). However, this source has experienced temporary interruptions in numerous instances by damage to the conveyance system from forest fires, floods, and landslides. Furthermore, EID has the ability to transfer water from Project 184 to Sly Park. Though this operational maneuver does not increase EID's system yield, it does increase the system's operational flexibility.

Folsom Lake provides surface water to EID's El Dorado Hills area. By contract with the United States Bureau of Reclamation (USBR) for Folsom water, EID is entitled to 7,550 acre-feet (ac-ft) per year. The USBR has imposed restrictions on the Folsom supply several times due to water shortages in the Central Valley Project. Starting in 1994, the USBR has operated under the M&I shortage policy of a maximum 25 percent cutback. In 2001 EID was also awarded a water right for an additional 17,000 ac-ft per year of water supply with storage in Folsom Lake, which is authorized under Permit 21112 for diversion and consumptive use. There are no cutback provisions on this Permit 21112 supply.

Pre-1914 ditch water rights include diversions from Weber Creek, Slab Creek, and Hangtown Creek. The ditch water right sources are subject to diminution in dry years. EID has taken these ditch water rights at Folsom Lake from 2002-2007 under a series of annual contracts with USBR. At present, EID is nearing completion of a project to obtain a long-term USBR contract to take these ditch water rights at Folsom Lake, and the necessary state and USBR authorizations to also take the Weber Reservoir storage water right at Folsom Lake on a permanent basis.

Recycled Water. EID operates two reclamation plants. Recycled water is used within the El Dorado Hills service area to offset potable demands and the need to develop new potable water sources. Recycled water is used for three main purposes: commercial landscape irrigation, residential landscape irrigation, and construction dust control.



--- EID Service Area Boundary

- | | |
|--|---|
| <ul style="list-style-type: none"> 1 Folsom Lake 2 Jenkinson Lake 3 South Fork American River / Kyburz 4 North Fork Cosumnes River / Crawford Ditch 4A Clear Creek / Crawford Ditch 4B Squaw Hollow Creek/East Diamond Ditch 5 Middle Fork Cosumnes River / Outingdale | <ul style="list-style-type: none"> 6 Weber Reservoir / Weber Dam 7 Weber Creek 8 Slab Creek 9 South Fork American River / Strawberry 10 Hangtown Creek 11 Bass Lake reservoir 12 Recycled Water / El Dordo Hills WWTP 13 Recycled Water / Deer Creek WWTP |
|--|---|

Source: EID Water Supply Master Plan, 2001

BROWN AND CALDWELL	PROJECT	130868	El Dorado Irrigation District, California	Figure 1-6
	DATE	1-14-08		

1.6.2 Water Demands

The past, current, and projected water demands for EID are described in the Phase 1 report and EID's 2005 urban water management plan (UWMP). The demand projections are based on the land use growth forecast alternative adopted in the 2004 El Dorado County General Plan. Projections use an analysis of the acreage within the region, and the water demands that would result if the acreage were developed in accordance with the forecast land uses and requirements. EID's historical year 2000 and 2005 demands were approximately 40,000 ac-ft and 48,000 ac-ft, respectively. Projected demands for years 2010 and 2020 are approximately 56,000 ac-ft and 73,000 ac-ft, respectively. The assumed growth rate is the average increase in demand experienced by EID between years 1989 and 1999. The annual rate of increase between years 2000 through 2005 was approximately four percent. EID estimates that its demand will increase at an overall 2.5 percent annual rate through 2030, corresponding to a demand projection of approximately 89,000 ac-ft by the year 2030. It is important to note that demand reductions as a result of additional future water conservation efforts are not included in these projections. Current conservation savings are incorporated and include all California Urban Water Conservation Council Best Management Practices. In this analysis conservation is included as a drought impact avoidance project alternative, and is further discussed in section 2.4.

1.7 EID Drought Management Policy

EID has adopted policies, regulations, and procedures to identify and address drought conditions. Guidance provided in EID policy and regulations is intended to reduce the potential for water supply shortfall and interruption of service. EID is subject to additional required or suggested water shortage planning guidance by county, state, and federal agencies. Subsection 1.6.1 discusses current applicable EID policy, administrative regulations, and supporting documents. Subsection 1.6.2 provides an overview of water supply shortage guidance from regulatory agencies. Subsection 1.6.3 discusses the reliability of EID's water system under its current drought policy. A timeline mapping the evolution of EID's water supplies, demand management, and associated policies is depicted in Figure 1-7.

1.7.1 Existing EID Policy, Regulations, and Procedures

Drought management at EID is currently guided by several key documents, consisting of two Board policies and three plans. These documents are described below.

The EID Board of Directors recently updated policy and administrative regulations addressing water supply shortage and drought conditions. The Board adopted on August 28, 2006, Board Policy (BP) 5000 Water Supply, including BP 5010 Water Supply Management and BP 5040 Drought Preparedness and Climate Variability, with associated administrative regulations (AR), which are presented in Appendix C. BP 5010 and BP 5040 supersede earlier regulations, including Regulation No. 2 – Water Supply Reliability (Adopted July 24, 1989, Amended August 6, 2001).

BP 5010 contains six ARs, with three of them addressing drought. AR 5010.2 addresses shortages and states, “The *Water Resources and Service Reliability Report* will use a system firm yield method to determine that sufficient water supply exists to meet potential demands. Under this methodology, approximately 95 percent of the time sufficient water supply is available to meet normal water demands, but during the remaining 5 percent of the time water shortages may occur. Such shortages may result in the implementation of voluntary or mandatory conservation measures.” AR 5011 defines the incremental conditions needed to manage increasing levels of shortfall. AR 5011 presents five water supply management conditions and references the *4-Stage Water Supply Matrix and Water Shortage Response Measures* to manage water supply during periods of drought. AR 5013 addresses water service restrictions during water supply conditions 3, 4, or 5. The *4-Stage Water Supply Matrix and Water Shortage Response Measures* can be found in Appendix D.

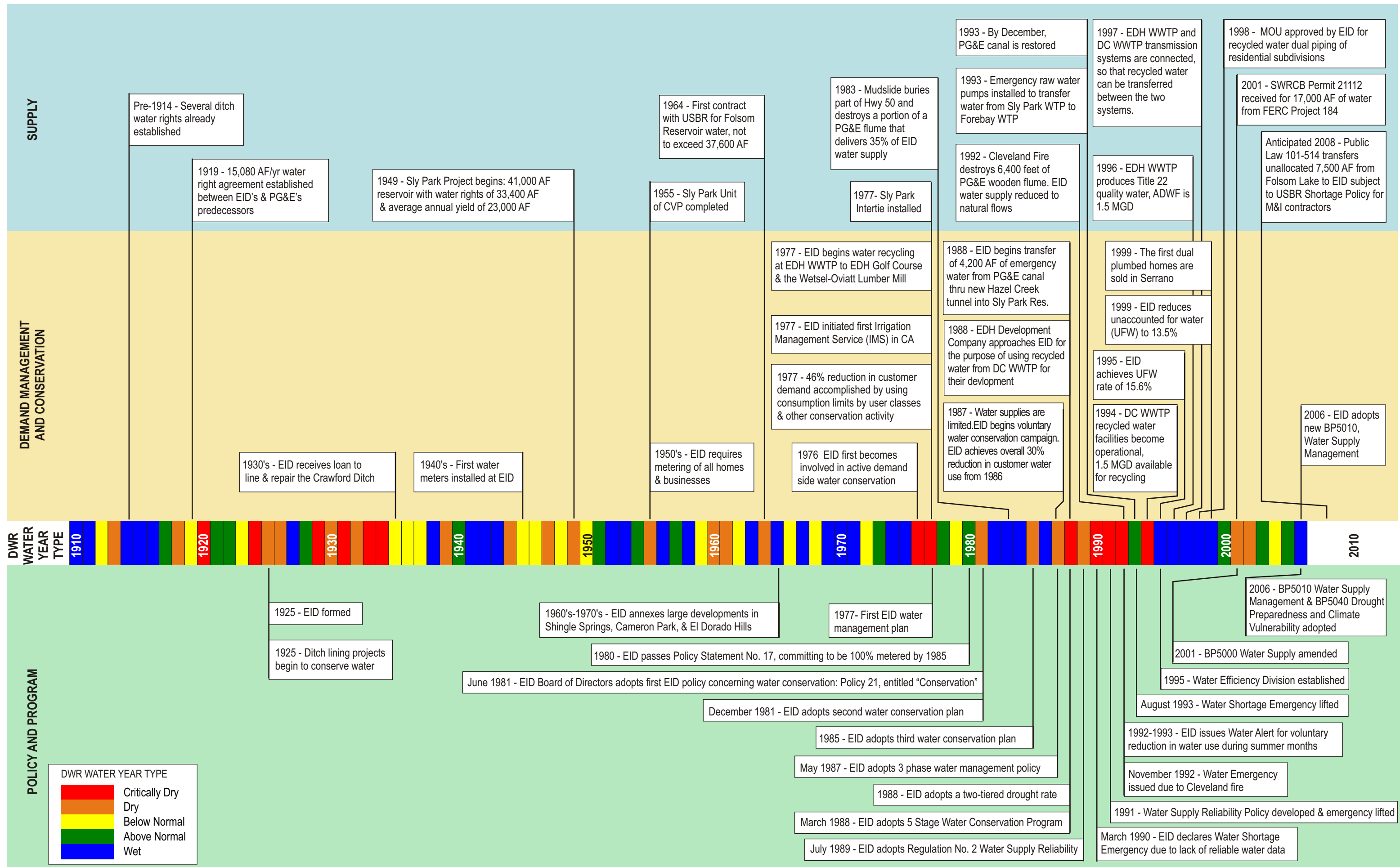


Figure 1-7. EID Demand Management Measures and Supply Source Timeline

BP 5040 expresses the Board's support for the adoption and implementation of a drought preparedness plan that includes consideration of climate variability.

EID adopted the *4-Stage Water Supply Matrix and Water Shortage Response Measures* (4-Stage Matrix) on June 12, 1995. The document defines trigger levels based on Sly Park storage volumes and demand management and other measures that respond to increasingly severe water shortage conditions. The 4-stage water shortage plan includes monitoring of Jenkinson Lake (Sly Park Reservoir) stage elevation by month as guidance in implementing measures designed to reduce water demand. Since Jenkinson Lake has historically been the main storage project in EID, serving approximately half of EID's water demand, it is used as the indicator to implement actions to reduce water usage during water emergencies.

Diversification of EID supply and increased operational flexibility are not recognized with the water supply matrix. The development of the SVM as part of this current drought planning effort is intended to better represent the current EID system and allow for the consideration of various drought management strategies that recognize EID's diversification of supply and operational flexibility. A major component of this Plan is to document the current and projected system reliability and projected supply shortfall using the 4-Stage Matrix and develop alternative approaches that maintain or improve system reliability while incorporating supply diversification and operational flexibility.

During the development of this Plan, EID staff considered how various supply and demand components would be managed during drought where existing guidance is absent. As a result, the *Draft Drought Ditch Operation Guidelines*, (Sept. 20, 2006) were developed. The guidelines identify ditch operation procedures during increasing drought severity and corresponding drought stages. The *Draft Drought Ditch Operation Guidelines* are included in Appendix E.

EID's *4-Stage Water Supply Matrix and Water Shortage Response Measures* was adopted on June 12, 1995, and is presented in Appendix D. It summarizes the principle resolutions adopted by the EID Board regarding usage allocation and allotments, penalties of excessive use, prohibition of nonessential uses, and education.

1.7.2 Regulatory Guidance

As the Plan was being developed, EID considered the required and suggested drought-related policies and guidelines provided by agencies with which EID maintains either a collaborative or contractual relationship. These guidelines are outlined in more detail in Appendix F. At the County level, there are currently no drought management guiding policies, neither by the EDCWA nor from the El Dorado County Environmental Management Department.

At the state level two entities guide EID drought preparedness and management. These state agencies and their requirements are summarized below.

- California Department of Water Resources (DWR) – An Urban Water Management Plan (UWMP) is required every five years and must incorporate a water shortage contingency plan. The urban water management plan for 2005 must project normal climate year water demands and supplies through 2025, and also define the single dry year water supply and the four year dry period. EID's 2005 urban water management plan projects adequate water supplies during the single dry year through 2030 based on the assumption that EID would have some new water supplies available.
- California Office of Emergency Services (OES) – The OES published a Water System Emergency Response Template in 1999 that includes a suggested Water Supply Interruption Action Plan consisting of four water use reduction stages that include: 1) a water alert with a 5 percent or greater water use reduction goal; 2) a water warning with a 15 percent or greater water use reduction goal; 3) a water crisis with a 30 percent or greater water use reduction goal; and 4) a water emergency with a 50 percent or greater water use reduction goal.

At the federal level, the USBR guides EID drought preparedness and management. The USBR has several requirements for their water supply contractors, which includes EID. Every five years, USBR water contractors, including EID, are required to submit a Water Management Plan (WMP) which must include a description of how reduced water supplies, including hardship water, are allocated. The WMP must also describe policies that address wasteful use of water and enforcement methods.

The USBR published in 2003 a drought planning handbook that suggests a 4-stage drought plan. This suggested strategy includes establishing water shortage triggers, balancing supply and demand, developing and implementing a water shortage strategy, evaluating water saved by staged reductions and select stage, monitoring production and use, implementing public outreach strategy and involve the media, and analyzing revenue and expenditure impacts.

The USBR has an Agricultural (Ag) and Municipal and Industrial (M&I) Shortage Policy – Central Valley Project that is applicable to USBR customers, including EID. The policy has the following requirements:

- Decrease agricultural water supplies to 75 percent of contractual water supply before M&I water supplies begin taking shortages.
- Then agricultural and M&I shortages ratchet down percent by percent until M&I water reaches 75 percent of its historic use and ag water is at 50 percent of its contractual water supply.
- When the M&I's 75 percent reliability sets in, M&I will remain at 75 percent of its historic use, and reduce agricultural water until agricultural supplies reach 25 percent of their contract water supply. Evaluate Central Valley Public water supply availability, public health and safety levels, hardship water for agricultural demands, etc.
- When ag water supplies are reduced to 25 percent, further reduce M&I water supplies.

1.7.3 Water Supply Reliability Status

As part of the development of this Plan, the reliability of EID's water system was evaluated when combined with EID's current drought indicators and triggers. For this analysis, reliability is defined as the volume of water supplied divided by volume demanded during the simulation period (historical or design drought) and expressed as a percentage. The demand volume can be less than normal demand during dry periods within the simulation period when demand cutbacks of up to 30 percent can be made based on the drought stages defined by EID's 4-Stage Matrix. The analysis is described in detail in Section 2 of this report. The results are briefly described below.

The analysis results show that the 4-Stage Matrix plan has a reliability of 100 percent with 2004 demands, which decreases to 88.9 percent with 2030 demands, based on the historical record period of 80 years. The reliability percentage would be less for the specific drought years embedded within the historical record. The percent of months that drought stages would be declared during the historical record period is 7 percent with 2004 demands and 39% with 2030 demands. This analysis is based on the current level of water supplies.

The analysis included a simulated 3-year drought that mimics the historical 1976-77 drought followed by a third year of 1977 conditions. The results show that the 4-Stage Matrix would be 100 percent reliable for the three year period with 2004 demands, and 33 percent reliable with 2030 demands. Note that in EID's 4-Stage Matrix, significant demand cutbacks of up to 30 percent would occur if triggered.

1.8 Stakeholder Involvement

Stakeholder participation, in accordance with the shared vision planning approach, was an important component of the project. The stakeholder team, consisting of staff, Board members and customers, dedicated time and energy to developing this Plan with analysis, input and review, as well as the extensive consideration of viable future drought monitoring efforts. With the recent media and political attention on

climate change and the dry 2007 water year, both staff and the community have been focused on this Plan development effort.

Considerable collaboration occurred during the Plan development including the following:

- Initial meetings between the consultant and EDCWA and EID to discuss regional drought analysis goals.
- A summary presentation at the El Dorado Water and Power Authority to familiarize regional stakeholders with the upcoming drought planning efforts.
- Several topic-oriented meetings with EID staff.
- A workshop to present and receive comments on the suggested approach to drought management.
- A workshop to present and receive comments on the drought plan content.

Initial discussions with project stakeholders included the system's individual complexities, existing and potential drought indicators and triggers, current drought response plans, the coordination of drought management strategies within the region, and specific stakeholder drought management concerns. After these preliminary meetings, the participating stakeholders representing EDCWA, EID, GFCSD and GDPUD gathered in a workshop setting on December 20, 2006 at EID to begin coordination between each individual's water purveyor's plans. On this date, industry experts Jon Olaf Nelson and William Werick traveled to the County to present their expertise on community drought response and drought indicators, respectively.

These meetings not only provided the system details, the purveyor perspectives, and the community insights necessary to best address drought monitoring and response for EID, but also derived a level of support, coordination, and opportunities available to and from EID with their neighboring water agencies. Significant consensus was reached on a number of topics including:

- 3-stage target percent reduction.
- Methodology to evaluate drought indicators and triggers.
- Development of drought response plan that promotes voluntary compliance.

1.9 Drought Preparedness Plan Approach

The approach to the development of the drought plan consisted of building off current policies and procedures, leveraging Phase 1 efforts, using the SVM, and incorporating EID staff knowledge and input.

The development of the Plan builds from existing policy and procedures and recognized past successes and lessons from previous drought periods. Phase 1 was completed as a collaborative County-wide effort to understand commonality across the water community while recognizing the individual strengths and challenges faced by each of the County's three west slope water agencies.

The SVM was developed to assess current and future water supply reliability and potential water supply shortfall during both drought and non-drought periods. The incorporation of climate change scenarios allows EID to consider future water supply conditions under a changing climate. The SVM was used extensively during development of the Plan, specifically to identify the best combination of drought indicators and drought trigger levels that maintain high system reliability in accurately declaring a drought stage.

EID staff were instrumental in the development of the Plan by representing EID and customer preferences and providing institutional knowledge of EID's policies, operational practices, and public outreach procedures. Significant guidance and review from EID staff are reflected in: 1) the drought stages and associated target demand reduction, 2) the approach to achieve needed customer response during drought, and 3) the Plan implementation actions.

The Plan and the associated SVM tool formalize and organize drought-related activities that staff will pursue as part of Plan implementation. The Plan is not intended to sit on the shelf and only be occasionally referenced for needed information. Section 3 of the Plan outlines specific Plan implementation activities and the associated schedule for completion.

1.10 Drought Preparedness Plan Content

The Drought Preparedness Plan is organized into three sections as follows:

- Section 1 provides an overview of the need for drought planning, EID water supply and demand with resulting water supply reliability, and policy and procedures guiding the development of the Plan.
- Section 2 details the Plan development process and results. Plan elements include 1) drought stages with associated demand reduction targets, 2) drought indicators and triggers, 3) methods to achieve the desired customer response during drought, and 4) projects that can be pursued to reduce the frequency of drought declaration.
- Section 3 provides guidance on implementation of the Plan. The implementation plan includes actions that are recommended for immediate Board of Directors consideration and a wide range of implementation actions to be completed during non-drought periods and each stage of drought.

EL DORADO IRRIGATION DISTRICT DROUGHT PREPAREDNESS PLAN

2. DROUGHT PREPAREDNESS PLAN DEVELOPMENT

Section 2 provides details on the development of this Plan's components including drought stage classification, drought indicators and trigger levels, EID and community drought response, and long-term drought impact avoidance projects. Drought planning and management experts William Werick and John Olaf Nelson supported the development of this Plan.

There are two primary goals in the development of this Plan: (1) create an acceptable Plan that meets normal demands in the driest conditions; and (2) determine if the current strategic mix of supply and demand drought management solutions will continue to be effective in the future. This evaluation focuses on the development of a drought plan that incorporates demand curtailments that can reasonably be met in drought conditions, is financially sustainable, is administratively appropriate and user-friendly, and will perform well for commercial, agricultural, environmental, and community interests (equity). The potential effects of climate change on drought conditions are also considered in this analysis. In order to design a drought management strategy that is fair, understandable, a low administrative burden, and revenue neutral, several key plan elements were assessed:

- **Drought stages.** This refers to the escalating degrees of drought conditions that determine targeted percentages of customer demand reduction in order to avoid shortfalls. Water supply conditions were identified and corresponding drought stage defined.
- **Drought indicators and associated trigger levels.** Potential indicators include reservoir levels, precipitation, snowpack water content, etc. These were evaluated for a historical correlation with the occurrence of drought. Trigger levels determine when a drought stage is declared. Various trigger levels for specific indicators were tested and coordinated with a drought-stage-demand reductions in order to minimize water supply shortfalls.
- **Drought response measures.** This refers to various customer demand reduction actions in response to drought. Potential responses consider extensive customer end-uses of water and water sources (potable, recycled, raw). The method of achieving effective water reductions (voluntary or mandatory), demand reduction policy enforcement methods, and coordination between EID and neighboring water purveyors was also investigated.
- **Drought impact avoidance projects.** This refers to long-term projects (i.e., additional storage and water rights) which reduce the likelihood of future water supply shortages. Reliability based on EID's historical record (1922-2004) as well as under a potential drier climate change scenario was calculated for various potential projects.

Balancing these plan elements was critical in the development of this drought plan and involved:

- declaring drought accurately,
- declaring drought early enough,
- minimizing how often drought needs to be declared;
- minimizing the duration of drought declaration; and
- expecting a reasonable and equitable customer response.

After defining drought stages and researching potential drought indicators, an iterative process was used to coordinate indicators, triggers, and customer demand reductions. Potential indicators were tested for historical correlations with drought. Concurrently, drought stage triggers and demand reductions were assigned to these indicators in order to minimize EID water supply shortfalls. An iterative process refined when water supply shortages were likely to occur and how soon curtailment of demand would have to start to be effective. “Indicators” based on historical correlations with drought are presented, and trigger levels for these indicators are defined. A balance between the indicators, triggers and response measures was critical to achieve water supply reliability. Section 2 summarizes the development of these elements.

2.1 Drought Stages

EID’s drought stages were defined by associating water supply conditions and demand reduction goals with drought stages. Drought stage definitions, as summarized in Table 2-1, were developed with input from a wide range of EID and EDCWA staff, including many of those responsible for managing public outreach and water supply and demand during drought. The percent of water supply reduction anticipated for each stage, and the corresponding percent of targeted demand reduction, are the basis for determining the most reliable drought indicators and trigger levels as well as the most feasible customer response actions. The anticipated supply reductions are up to fifteen, thirty, and fifty percent, for drought Stage 1, Stage 2, and Stage 3, respectively. To ensure an effective progression through drought stages (not too fast or too slow), three drought stages have been developed, as opposed to EID’s existing 4-stage plan.

Water supply conditions	Drought stage
Normal 0% Total Supply Reduction	Drought Stage Zero - Ongoing Conservation.
Slightly Restricted Water Supplies Up to 15% Total Supply Reduction	Drought Stage 1
Moderately Restricted Water Supplies Up to 30% Total Supply Reduction	Drought Stage 2
Severely Restricted Water Supplies Up to 50% Total Supply Reduction	Drought Stage 3

2.2 Drought Indicators and Trigger Levels

Drought indicators and associated trigger levels function to declare a drought early enough to maximize saved water, but not so early that false drought declarations are issued. False drought declarations can result in unnecessary revenue losses and compromised community faith in EID. The best drought indicators for monitoring and assessing the onset and severity of drought are those with a strong correlation with actual EID water supply conditions. Using the best drought indicators, multiple numeric trigger levels are defined that correlate to anticipated supply shortfalls (e.g. 15 percent, 30 percent, and 50 percent). Indicators and associated drought stage triggers coordinate with drought stage demand reductions to avoid water supply shortfall.

Using the SVM, four trigger plan scenarios are evaluated in this section based on resulting system reliability and percent time in drought:

1. No Plan – no drought indicators, triggers, or drought stage demand reduction goals.
2. Current – based on EID’s 1995 4-Stage Matrix (see Appendix D) that considers Sly Park Reservoir levels.

3. Experimental – more comprehensive than the current method with consideration of numerous indicators to improve EID water supply reliability. These indicators include Sly Park Reservoir inflows, Sly Park Reservoir levels, and DWR’s Water Year Type (shown in the information box).
4. Supply Remaining Index (SRI) – most comprehensive plan and more robust in considering the status of all EID supply sources along with projected future supply and demand.

Triggers are determined experimentally with the intention of being as straightforward and effective as possible.

2.2.1 Current Trigger Plan

EID’s current plan, described in Section 1 and found in Appendix D, is based on Sly Park Reservoir levels and a 4-stage drought response. EID’s system reliability with no drought plan was evaluated against their current plan. The percent of time EID needed to enact their drought plan was also measured. A comparison of EID’s historical and projected system reliability is presented in Appendix G. Calculated system reliability is shown for EID’s 1922-2004 historical record as well as under the design drought 1976, 1977 and repeated 1977 dry year hydrological conditions. The “No Plan” scenario assumes no drought plan or demand curtailment is enacted over the course of the historical record or during design drought conditions. The “Current Plan” scenario assumes EID’s enactment of their current 4-stage water shortage plan, including demand cutbacks of up to 30 percent if Sly Park levels are low enough.

Water Year Types

Sacramento Valley Water Year Index =

Sum of Sacramento River unimpaired flow above Bend Bridge, Feather River unimpaired inflow to Oroville Reservoir, Yuba River unimpaired flow at Smartville, and American River unimpaired inflow to Folsom Reservoir.

Sacramento Valley Water Year Index

= (0.4) x Current Apr-Jul runoff forecast (in million acre-foot) + (0.3) x Current Oct-Mar runoff (in million acre-foot) + (0.3) x Previous Water Year’s Index.

This index, originally specified in the 1995 SWRCB Water Quality Control Plan, is used to determine the Sacramento Valley water-year type as implemented in SWRCB D-1641.

Year types are set by first of month forecasts beginning in February. Final determination is based on the May 1, 50 percent exceedance forecast.

Water years 1, 2, 3, 4, and 5 represent water years types wet, above normal, below normal, dry, and critically dry, respectively.

2.2.2 Experimental Trigger Plan

In developing the experimental trigger plan, the following regional indicators were evaluated: reservoir storage levels (including Sly Park and Folsom Lake), DWR water year type, snow pack water content, precipitation, streamflows, and ENSO climate cycle episodes (described in the information box). Specific indicator trigger values can reliably predict impending drought if developed from good statistical correlations, and if based on the historical database with a strong physical connection to water supply variability.

To determine the most reliable indicators for EID, a computer model was created to identify correlations between projected SVM-derived EID water supply shortfalls, with enacted drought response plan demand curtailments, and historical indicator data sets to see which indicators reliably predict drought. A monthly “shortfall” occurs when there is not enough water in storage (even with a given month’s inflows) to meet defined curtailed monthly demand.

Ideally to avoid confusion, droughts would be declared for all utilities in the region at the same time. However, since water agencies have varying potential for carryover storage and shortfalls are driven by varying demand and inflows to storage, the differing County water systems cannot realistically declare drought at the same time and therefore do not have identical indicators and triggers.

Selecting robust indicators and setting a trigger value for each drought stage to minimize supply shortages requires trial and error experimentation. This process was informed by an understanding of how the EID

physical water supply system works and a mathematical analysis of potential water shortfalls. Various indicator values were tested to determine indicator values for each stage that were “triggered” soon enough to warn for drought and late enough to correlate well with drought. Potential drought indicators and corresponding trigger levels were tested by comparing how accurately they predict drought over the entire hydrological record (1922-2004). Those that perform well predict drought during past EID drought periods and not predict drought during periods of no drought. For each indicator and trigger iteration, the number of true positives and false negatives (good) were compared to the number of false positives and true negatives (bad). The concept is further described in the adjacent information box, Indicator-Trigger Result Types.

In determining the most reliable indicators, the analyses included mathematical correlations and scatter diagrams to assess for possible relationships between indicator behavior and historical droughts. Individual historical dry year sequences were specifically examined to test if the indicators were truly identifying water supply shortages (when there was actually drought). There is strong correlation between EID’s shortfalls and Sly Park levels, inflows, and ENSO episodes. On the other hand, there was no consistent correlation found between EID shortfalls (EID drought) and snow pack water content or any regional precipitation gage data. The indicators and triggers successfully derived in the correlation model were iteratively built into the SVM to function with demand reductions to improve the reliability of EID’s

**ENSO Climate Cycles
(El Niño - Southern Oscillation)**

The ENSO cycle refers to the coherent and sometimes very strong year-to-year variations in sea-surface temperatures, convective rainfall, surface air pressure, and atmospheric circulation that occur across the equatorial Pacific Ocean. El Niño and La Niña represent opposite extremes in the ENSO cycle.

El Niño refers to the above-average sea-surface temperatures that periodically develop across the east-central equatorial Pacific. It represents the warm phase of the ENSO cycle, and is sometimes referred to as a Pacific warm episode.

La Niña refers to the periodic cooling of sea-surface temperatures across the east-central equatorial Pacific. It represents the cold phase of the ENSO cycle, and is sometimes referred to as a Pacific cold episode.

The indicator considered for use in the drought response plan is a measure of *anomaly* - the difference between current sea surface temperatures and the 1971-2000 base period in the so-called 1Niño 3.4 region (5°N-5°South, 120°-170°West).

An ENSO index of less than zero means cooler than normal sea surface temperatures – a La Niña event. The droughts that began in 1976 and 1988 were preceded by La Niña.

El Niño and La Niña Seasons (historical years)	
El Niño - Weak to Moderate	57-58, 65-66, 77-78, 87-88, 92-93, 94-95, 02-03
El Niño - Strong	72-73, 82-83, 91-92, 97-98
La Niña - Weak to Moderate	50-51, 56-57, 64-65, 70-71, 71-72, 74-75, 98-99, 00-01
La Niña - Strong	55-56, 73-74, 75-76, 88-89

system. EID’s reliability was tested based on EID’s historical record (1922-2004), however, system reliability under the design drought conditions (1976, 1977, 1977 *repeated* hydrology) and varying climate change conditions were also analyzed. This was an iterative process between identifying reasonable triggers levels and achieving the most reliable system response. Both EID’s system reliability and the amount of remaining shortfall were examined.

From the indicator-trigger iterative process the most favorable combination of indicators for EID were Sly Park storage levels, DWR water year, and Sly Park inflows. The experimental drought indicator and trigger plan is summarized in Table 2-2. The logic is applied sequentially starting with the January scenario.

Indicator-Trigger Iteration Result Types

True positive (TP) – drought happens (true) and the trigger is pulled (positive).

False negative (FN) –no drought (false), and the trigger reads “no drought” (negative)

True negative (TN) – drought happens, but the indicator didn’t trigger a warning.

False positive (FP) – no drought, but the indicator triggers drought and reduces demand unnecessarily.

Table 2-2. EID Experimental Trigger Plan Summary Table

Month	DWR water year Oct-Jan	Oct-Jan inflow to Sly Park	Sly Park Storage, ac-ft	Last month's stage	This month's stage
January	>3	<30% normal	<24,000	0	If 2 of the 3 conditions are met, Stage 1
				1-3	If 2 of the 3 conditions are met, last month's drought stage
Feb-June			< last month	Any	Increase last month's stage by 1 up to the maximum Stage 3 declaration
Any month with drought stage > 0 in previous month			> target*	Any	Stage 0 (no drought)
			< target	Any	Same stage as last month

Notes: All rules applied at the end of the month shown

* The Sly Park storage target varies based on the month (EID 4-Stage Water Supply Matrix and Water Shortage Response Measures, 1995)

October – 15,900 ac-ft	November – 14,000 ac-ft	December – 13,300 ac-ft
January – 14,000 ac-ft	February – 16,300 ac-ft	March – 18,800 ac-ft
April – 22,600 ac-ft	May – 26,000 ac-ft	June – 27,600 ac-ft
July – 25,800 ac-ft	August – 23,100 ac-ft	September – 19,200 ac-ft

The experimental indicator and trigger plan includes the following, with the logic applied sequentially:

1. At the end of January when two or three of the following three indicators are triggered,
 - DWR Water Year >3;
 - October to January cumulative inflows to Sly Park < 30 percent average;
 - Storage in Sly Park < 24,000 ac-ft

A Stage 1 drought is declared (if the previous month was not in drought); otherwise, the previous month's drought stage continues if it was Stage 1, 2, or 3.
2. In months February-June, if storage in Sly Park decreases from the previous month, then the drought stage is increased by 1 until Stage 3.
3. In February through June, if Sly Park reservoir levels rise over EID's current 4-stage water supply matrix Stage 1 Sly Park trigger level for any month, a drought is called off (go back to drought Stage zero).
4. In all other cases, the last month's drought stage - whether it was zero, 1, 2 or 3 - continues into the next month.

The reliability of EID's system with no drought plan, EID's current plan, and the EID experimental drought trigger plan scenarios is presented in Appendix G. EID has adequate policies in place through 2010 with the current plan, but by 2020 would be able to further increase system reliability and reduce time under drought declaration with the experimental trigger plan.

2.2.3 Supply Remaining Index Trigger Plan

In wanting to create a more robust trigger plan, incorporating more indicators as well as further increasing EID's system reliability, a more sophisticated drought trigger plan was developed considering the number of days of water supply remaining. When the number of days supply remaining (DSR) is low, there is a limited amount of water supply left and drought restrictions should be imposed to stretch the supplies for a longer

period of time. This more comprehensive indicator better represents EID's water supply situation than the experimental trigger plan approach which only considers monitoring Sly Park storage levels and inflows. The DSR indicator incorporates expected future supply and demand, and is calculated at the end of each month in the simulation. The DSR indicator is a function of:

- Current storage in Sly Park Reservoir, Echo Lake, Lake Aloha, Silver Lake, and Caples Lake;
- Worst case expected inflows - conservatively based on the minimum monthly hydrology (reservoir inflows) in the historical record (1922-2004); and
- Normal (unconstrained) demand in the coming months - projected demand by month. In determining the reliability under these conditions, demand projections are based on a modeled demand year.

It is important to stress that the DSR indicator is not the actual number of days of supply remaining, since it considers the historically worst inflows rather than probable inflows. Using probable inflows would increase the estimate of days supply remaining. On the other hand, DSR does not reflect leakage or evaporation, which would slightly reduce the days supply remaining. The DSR indicator is a useful tool that predicts when the utility needs to reduce water demand.

To represent EID's remaining water supply, a days supply remaining index (SRI) was developed. SRI calculates the DSR remaining 20 months into the future, while estimating when the specific day shortfall occurs. This SRI value represents the days supply remaining with a value between zero and one. For example, a monthly SRI value of 0.0 indicates that the DSR is the lowest value in the entire 1922-2004 historical record for that month, which correlates to extreme drought conditions. A SRI value of 1.0 means that the DSR is the highest possible DSR in the historical record for that month, which correlates to extreme wet conditions. Figure 2-1 presents a flow chart of EID's Drought Status SRI Trigger Plan. EID's Drought Status SRI Trigger Plan also includes a subordinate indicator ENSO episode. A real-time *Drought Status SRI Model* can be found on a CD in Appendix A.

Input into the *Drought Status SRI Model* includes actual EID reservoir levels at Sly Park, Echo Lake, Lake Aloha, Silver Lake, and Caples Lake. There are links to Echo Lake, Lake Aloha, Silver Lake, and Caples Lake available in the model so the user can click and retrieve the most-recent storage level information. The SRI model determines the current date and then fetches the ENSO episode value from the National Oceanic & Atmospheric Administration (NOAA) Climate Prediction Center website, picking the appropriate values based on the date. Likewise, the model also automatically obtains DWR water year type. Then the Drought Status SRI model evaluates this latest actual data to calculate the drought stage for the coming month. The historical odds that the current drought stage will end in the next two months is also calculated. ENSO values and DWR water year type values can also be manually entered, as can all of the other currently "set" input parameters. These parameters include projected monthly demand and inflows, plus drought stage SRI and ENSO trigger values. Again, these indicators and trigger values were developed to achieve optimal EID system reliability based on the historical record. A screen shot from the *Drought Status SRI Model's* dashboard sheet is shown in Figure 2-2.

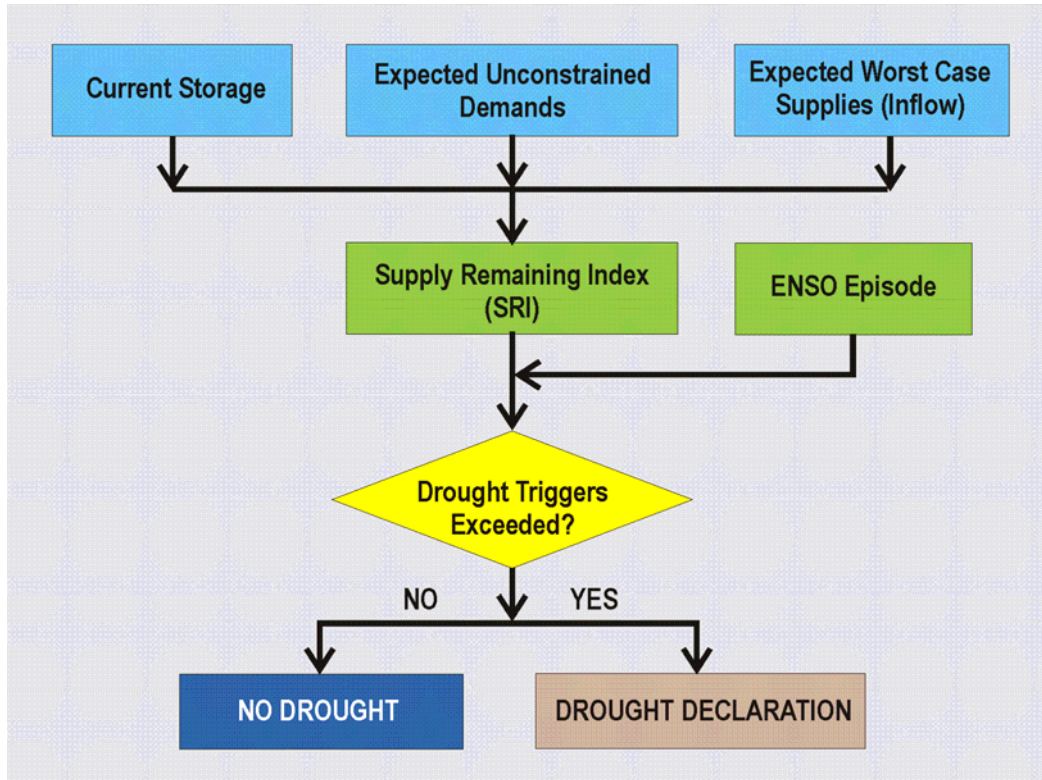


Figure 2-1. Drought Status SRI Trigger Plan Flow Chart

Today's Drought Status in EID Today is Thursday 10/11/2007 [Help](#)

Under the terms of the Drought Status SRI plan, EID is not currently in drought. The current supply remaining index (SRI) is 0.61. Based on the 1923-2002 water supplies, there is a minimal chance of a drought being declared in the next two months.

Drought Stage and Supply Remaining Index for November using 2010 demands.

Drought Stage NOW:	No Drought	Enter last month's stage:	0 More details
SRI:	0.61	<small>SRI ranges from 0-1 and is based on days supply remaining as a function of current storage, worst-case expected supplies, and normal (unconstrained) demand in the coming months. (go to HELP sheet for more info)</small>	

Climate Cycle Episode (El Nino Southern Oscillation - ENSO) and Water Year Type Data are fetched automatically from websites

ENSO	-0.6	<small>Warm (positive value) and cold (negative value) episodes are based on a threshold of +/- 0.5 degrees Celcius for the Oceanic Niño Index (ONI), based on the 1971-2000 base period. The ENSO value to the left is for August-September-October, 2007.</small>	
Current Water Year Type (1-5):	4	<small>Water Year was automatically obtained from California DWR May 1, 2007. A water year type value of 1 corresponds to a wet year, 5 to a critically dry year.</small>	

Enter Current Reservoir Storage (acre-feet): (click on underlined Lake name to link to online data source and update data manually)

<u>Sly Park</u>	30,408	<small>Sly Park is 74% full.</small>
<u>Echo Lakes</u>	296	<small>Echo Lakes are 15% full.</small>
<u>Lake Aloha</u>	943	<small>Lake Aloha is 18% full.</small>
<u>Silver Lake</u>	4,063	<small>Silver Lake is 47% full.</small>
<u>Caples Lake</u>	14,187	<small>Flashboards should be in place in Caples Lake. Based on that, Caples is 64% full.</small>

Figure 2-2. Drought Status SRI Model Dashboard Screen Shot

The EID SRI trigger plan is presented below and summarized in Table 2-3.

- If it's May and SRI is less than 0.6 go to Stage 1 (if in Stage 0); if already in drought and SRI is less than 0.75, stay at the stage from the month before.
- In June through September, if SRI is less than 0.10 and the previous month was in a Stage 2 drought, then go to Stage 3.
- In June through September, if the SRI is less than 0.12 and the average previous three months ENSO is less than 0.35, then go to Stage 2; if the previous month was in Stage 3 drought, stay in Stage 3.
- In all months if SRI is greater than 0.75, there is no drought curtailment. This either continues a period of no drought or ends the drought response of the month before.
- In all other cases, the drought stage this month is the same as the previous month.

Table 2-3. SRI Trigger Plan Summary Table

Month	ENSO	SRI	Last month's stage	This month's stage
May	Any	<0.6	0	1
		<=0.75	1,2,3	Last month's stage
June - Sept	Any	<0.10	2	3
	<0.35*	<0.12	0,1,2	2
	<0.35*	<0.12	3	3
Any	Any	>0.75	0,1,2,3	0

* the ENSO average of three previous months must be less than 0.35

To declare a drought, indicator levels can only be triggered starting in May. No indicator and trigger combination earlier in the year consistently improves EID's system reliability while minimizing drought declarations. Additionally, the *Drought Status SRI Model* also calculates the historical odds that a drought will be declared in the following two months which allows for estimating a look ahead prior to May.

The trigger values of the SRI plan were selected by SVM-based optimization and experimentation under 2010 demands and 2004 EID operations to achieve maximum supply and delivery reliability while minimizing EID's enactment of curtailment policy stages. A summarized comparison of EID's reliability based on no drought plan, the current plan, the experimental plan, and the SRI trigger plan is presented in Appendix G.

2.3 Drought Response

This section describes customer water end-uses, water sources (potable, recycled, raw), and drought policy enforcement methods by drought stage. Additionally, the necessity for drought plan compatibility between EID and its neighboring water purveyors is addressed. Drought response expert John Olaf Nelson assisted in the development of EID's drought response plan.

EID is charged with adopt regulations and restrictions on the delivery and consumption of water supplied for public use that will, in the sound discretion of the Board of Directors, conserve the water supply for the greatest public benefit with particular regard to domestic use, sanitation, and fire protection, and, to the extent that additional water is available, promote and regulate use of same in a manner that minimizes the economic impact on the water service community.

The specific drought stage water use reduction targets as summarized in Table 2-4 were developed in a rationing model that uses output from the SVM to allocate water supplies to various customer classes during drought. The drought response component of the Plan involves an introductory Stage 1 drought response

during which all customers are informed of drought and total customer demand reduction is targeted for up to 15 percent. In the preliminary voluntary phase of Stage 2, water use decisions continue to be entrusted to the customer as long as the overall reduction goal of up to 30 percent is met. This is the Stage 2 Voluntary Phase which uses the honor system approach. If Stage 2 targets are not met, then a Stage 2 Mandatory Phase is implemented. If further water use cutbacks are necessary a strict allotment approach is implemented with a stiff penalty rate in Stage 3 with a total demand reduction goal of up to 50 percent. Specific customer category allocations are based on water use typical of the region and regional customer response during drought.

Table 2-4. Drought Stage Response Summary

Water supply conditions	Drought stage	Objective	Response actions
Normal 0% Total Supply Reduction	Drought Stage Zero - Ongoing Conservation. Water waste prohibition in effect	Public awareness	Normal actions
Slightly Restricted Water Supplies (below normal) Up to 15% Total Supply Reduction	Drought Stage 1 – Introductory Stage. Voluntary reductions in use	Initiate public awareness of predicted water shortage and encourage conservation	Encourage voluntary measures to decrease “normal” demand up to 15%
Moderately Restricted Water Supplies Up to 30% Total Supply Reduction	Drought Stage 2 – Voluntary Phase for water use reductions and potential subsequent Mandatory Phase with restrictions on use	Increase public understanding of worsening water supply conditions, encourage voluntary conservation measures, and enforce some mandatory conservation measures	Encourage some voluntary measures and enforce mandatory measures and implement water rationing to decrease “normal” demand up to 30% Drought surcharge enacted (potential in-house trigger and Board action)
Severely Restricted Water Supplies Up to 50% Total Supply Reduction	Drought Stage 3 – Mandatory restrictions (severe prohibitions) on use	Ensure that water use is limited to health and safety purposes	Enforce extensive restrictions on water use and implement water rationing to decrease demand up to 50% of “normal” demand

The two response approaches, (1) a voluntary honor system based approach, and (2) a mandatory prescriptive approach, each have advantages and challenges for achieving customer water use reduction. The voluntary approach, which depends on the honor system, focuses on educating customers on water use practices. This tactic relies on voluntary behavior modification to achieve targeted water use reduction. For example, a residential customer may choose to shower faster (using less water) instead of not watering her tomatoes. The prescriptive approach requires a very encompassing list of managed water use activities that are mandatory and require enforcement.

A comprehensive set of prescriptive curtailment policy measures by customer class and drought stage for EID can be found in Appendix H. The general response policies for each drought stages are listed below. Note that an asterisk* has been placed next to existing EID drought policies.

2.3.1 Drought Stage Zero – Normal Conditions and Ongoing Conservation

When water supply conditions are normal with no reduction in water supplies, EID is in a Stage Zero drought. Under normal conditions, a water waste prohibition will identify items of waste that are to be avoided at all times. A suggested water waste prohibition for EID can be found in Appendix I. Prohibitions include limited sidewalk washing, no car washing without a shutoff nozzle, and fixing leaks within 72 hours. Additionally, there are several early preparedness components that EID should consider to better handle drought:

- Trucking contracts
- Tap manifolds for emergency water distribution
- IMS expansion for agricultural customers
- Rate stabilization policies
- Communications plan
- Public outreach plan
- Domestic Irrigation customers are strongly suggested to have a water conservation plan on file with EID and update this plan every 5 years.
- Agricultural Metered Irrigation (AMI) customers not participating in the IMS program are strongly suggested to have a water conservation plan on file with EID and update this plan every 5 years.
- Small Farms must submit a water conservation plan during the account certification to qualify for Small Farm rate. The plan must be updated every 3 years during the re-certification process.
- Long-term adjustments in reservoir release rules
- Institutional changes
- Legal changes
- Plumbing retrofits adjustment to ensure use of more efficient equipment
- Water efficient indoor plumbing fixtures

2.3.2 Drought Stage One - Introductory Voluntary Phase

When EID water supplies are slightly restricted, with a reduction in supply up to 15 percent, EID is in a Stage 1 drought. In this introductory stage, customers are informed of drought conditions and of actions to take that will reduce demand. Furthermore, customers are asked to voluntarily reduce water use by 15 percent. This stage generally lasts only a month or two or the minimum time needed by EID to adjust the Plan to fit the situation at hand. In this stage EID should reacquaint customers with the water waste prohibition. Though this stage is voluntary, specific guidelines for customers are listed below. Note that an asterisk* has been placed next to existing EID drought policies.

- Apply irrigation water only during the evening and early morning hours (8 PM to 6 AM) to reduce evaporation losses.
- Inspect all irrigation systems, repair leaks, and adjust spray heads to provide optimum coverage and eliminate avoidable over-spray.
- Change the minutes of run-time for irrigation valves consistent with fluctuations in weather as determined by evapotranspiration (ET) data, obtained from EID or ET controllers.
- Reduce minutes of run-time for each irrigation valve if water run-off (gutter flooding) is occurring.
- Utilize water conservation incentive, rebate, and giveaway programs to replace high water-using plumbing fixtures and appliances with water efficient models.
- Take advantage of the free information available from EID on how to use water efficiently, read a water meter, repair leaks, and irrigate efficiently.
- Do not refill a swimming pool that had been drained.*
- Fix leaks.*

- Wash vehicles from a bucket. Use a hose equipped with a shutoff nozzle for a quick rinse (commercial car washes exempted). *

2.3.3 Drought Stage 2 - Community Cooperation to Achieve Reductions

When EID water supplies are moderately restricted, with a reduction in supply of up to 30 percent, drought Stage 2 with voluntary, community-oriented restrictions with potentially mandatory restrictions on use is enacted. If the Stage 2 Voluntary Phase approach is not effective or becomes unfair to too many customers, then the Stage 2 Mandatory Phase will be implemented. The achievement of the reduction goal is measured by overall performance of the entire customer population, based on EID production meters. It is important to note that user category demand reduction goals are not by individual customer, but are the goal for the customer category. In this stage, results are reported weekly to customers in the local newspaper. Customers are informed that individual meter records will not be audited or fees levied if overall water use reduction goal is achieved. Furthermore, customers who can conserve more are strongly encouraged to help customers who would incur economic hardship if they met the water use reduction goal. However, there should be a drought hotline for reports of misuse of water or when an official spots and reports a misuse. A violation process will be implemented for the violating site. More specific guidelines and restrictions are listed below.

- Indoor residential use (excluding irrigation only use) is targeted to approximately 70 percent of the amount used when no water use reduction was required.
- Any “irrigation only use” is targeted to approximately 55 percent of the amount used in the base year. (Higher demand reductions here to save water use in other areas that would force job cuts).
- Commercial, industrial and institutional use is targeted to approximately 80 percent of the amount used by the customer in base year.
- Restricted use of water from a fire hydrant - use limited to fighting fires, human consumption (hauling from designated sites allowed by persons whose wells have gone dry with EID Board approval), stock water, essential water quality flushing and toxic clean-up purposes.
- No watering of any existing turf grass, ornamental plant, garden, landscaped area, tree, shrub or other plant except by hand held hose or container, drip irrigation system, or other approved EID conservation practice.
- No watering of new turf grass or replacement turf grass.
- No initial filling of any swimming pool.
- No automatic serving of drinking water at dining establishments except with patron request. *

Agricultural customers will be affected as follows:

- Domestic Irrigation and AMI customers not participating in the IMS program, but who have a water conservation plan on file with EID, will reduce water use by 15% of the base year or face financial penalty.
- Domestic Irrigation and AMI customers not participating in the IMS program and who do not have a water conservation plan on file with EID will reduce water use by 25% of the base year or face financial penalty.
- Small Farm customers will reduce water use by 15% of the base year or face financial penalty.
- New commercial crop plantings that are already in the ground will receive the full amount of water needed to ensure the survival of the crop.
- New crops not in the ground at the time will not be irrigated using EID supplied water.

In determining compliance with Stage 2, the water purveyor will rely on water production meters to check compliance. Individual consumption meters will generally not be read for enforcement purposes. During Stage 2, it is assumed that customers will cooperate and unselfishly work together in harmony to successfully achieve the overall water use reduction goal. In the case of complaints or blatant non-compliance observed by water purveyor employees or other government officials, and brought to the attention of the designated official, enforcement will be pursued.

2.3.4 Drought Stage 3 - Mandatory Restrictions

When EID water supplies are severely restricted, with a reduction in supply up to 50 percent, a drought Stage 3 is enacted and all Stage 1 and Stage 2 water shortage response measures become mandatory. In the case of a very severe drought, EID may announce that Stage 2 is an interim step to be followed by Stage 3 on a certain date. Stage 3 includes an allotment for each customer account with a penalty rate applying for all water used in excess of the allotment. Stage 3 is very expensive for the utility since an extraordinary amount of extra staff time and expense would be required to conduct and manage the plan. Stage 3 requires the enforcement of demand reductions by individual account. Also, many variance requests can be expected and must be dealt with. If a connection to the water system was not in existence or was not active in the base year, EID will estimate the base year use based on customers having similar end uses. Under the variance process, EID may also increase or decrease the allotment for any customer if it is determined that special circumstances exist and that to do so would better achieve equity in allocation of available water or better meet health and safety concerns. More specific rules are listed below.

- Residential meters serving single family detached homes are granted 68 gallons per day per permanent occupant.
- Residential meters serving multiple units are allotted 50 percent of the amount used by the customer during the corresponding billing period in the base year.
- Irrigation only meters are granted 35 percent of the amount used by the customer during the corresponding billing period in the base year.
- Meters serving any non-residential use are granted 60 percent of the amount used by the customer during the corresponding billing period in the base year. (Note: Vital healthcare and public safety use is set at 65 percent).

Agricultural customers will be affected as follows:

- Domestic Irrigation and AMI customers not participating in the IMS program, but have a water conservation plan on file with EID, will reduce water use by 30% of the base year or face financial penalty.
- Domestic Irrigation and AMI customers not participating in the IMS program and do not have a water conservation plan on file with EID will reduce water use by 50% of the base year or face financial penalty.
- Small Farm customers will reduce water use by 30% of the base year or face financial penalty.
- IMS Agricultural customers must utilize program or surcharge enacted.

2.4 Drought Impact Avoidance

The substantial impacts of drought can be more effectively avoided with long-term planning efforts including education, policy, and infrastructure-based mitigation measures. Initially investigated and developed in Phase 1 of this effort, several drought impact mitigation alternatives for EID's water system were enhanced and refined in updating the SVM for this Phase 2 analysis.

The SVM (found in Appendix A) simulates several drought impact avoidance projects that include both demand reduction and supply augmentation alternatives. These projects are included as toggles in the SVM

and incorporate relevant capacities, hydrology, and infrastructure constraints. Many of these alternatives were researched by the participating purveyors independently, and all were discussed in detail and recommendations provided at the Phase 1 DAC workshops. The alternative's check boxes or drop down menus allow a user to compare various potential water agency "behavior" versus anticipated supply shortfalls.

Table 2-8 summarizes potential long-term reliability improvement projects (also referred to as drought mitigation and drought impact avoidance projects) for EID.

Table 2-5. EID Drought Impact Avoidance Project Alternatives

Project	Quantity
PL101-514 supply	7,500 ac-ft/yr
Water Conservation	3,247 ac-ft (in Year 2010) 3,175 ac-ft (Year 2020) 5,066 ac-ft (2030)
Water Loss Reduction	2,000 ac-ft/yr
Groundwater Banking	50,000 ac-ft
White Rock Diversion	20,000 ac-ft
Sly Park Flashboards	1,280 ac-ft
Alder Creek Reservoir	11,250 ac-ft
Texas Hill Reservoir	10,050 ac-ft
Capps Crossing Reservoir	14,000 ac-ft

Potential drought mitigation projects include revised water rights and contracts, water conservation, water-loss reduction, additional storage, and regionally collaborative projects. Details on these alternatives and the assumptions involved in their analysis are as follows:

PL101-514 supply includes a proposed 7,500 ac-ft/yr of legislatively transferred, unallocated Central Valley Project Supply water from Folsom Lake to EID. This allocation would be subject to USBR's Shortage Policy for Municipal and Industrial Contractors with maximum dry year reductions of 25 percent. This supply is modeled in the SVM as a monthly supply augmentation to the El Dorado Hills area.

Additional water conservation is modeled as the potential treated and raw water saved due to additional conservation activities.

Water loss reduction improves the distribution system so that system water loss could be reduced by up to 2,000 acre-feet per year (ac-ft/yr). Actions consist primarily of lining or piping the EID Main Ditch, advanced pressure management, decreased leak repair times, and additional meter testing, repair, and replacement. This additional "supply" is modeled in the SVM as a monthly demand reduction.

Climate Change Factors

Projections of future climate change point to changes in seasonal river flow patterns. This includes decreased amounts of water stored in snow pack, reductions in annual precipitation, and an increase in the extent and frequency of drought. In this study, climate change scenario factors are used that represent the relationship between actual hydrology and four types of potential shifts in hydrologic runoff conditions. Based on regionally applied scenarios developed by Dr. Jay Lund, these are the same data sets used in the forecasting tools for the Department of Water Resources, Bulletin 160: California Water Plan and the California Energy Commission Climate Change Report. Dr. Lund's information for American River watershed inflows to Folsom Lake under four different scenarios is used to index the runoff hydrology to reflect the possible impact due to climate change. Most climate change models for California project a warming trend. With this warming trend there are four climate change scenarios modeled: 1) Scenario A – HCM 2050, a warmer and wetter climate in year 2050, (2) Scenario B – PCM 2050, a cooler and drier climate by year 2050, (3) Scenario C – HCM 2100, a warmer and wetter climate by year 2100, and (4) Scenario D – PCM 2100, a cooler and drier climate year 2100. Scenario D represents the potential "worst case" climate change scenario for drought. Additional information on how these climate change scenarios are modeled in this analysis can be found in the Phase I report.

Groundwater banking is modeled in the SVM as an El Dorado Hills “supply” reservoir with a maximum capacity of 50,000 ac-ft. This option serves to meet unmet demand by acting as a virtual “bank” and storing unused available El Dorado Hills water supplies in a groundwater basin. These wetter year supplies can then be contractually “swapped” for upstream surface water supplies during dry years.

White Rock Diversion allows for 20,000 ac-ft of water storage in SMUD reservoirs under normal year conditions, with an additional 15,000 ac-ft available for carryover purposes.

Due to necessary further investigations by EID, the Sly Park Flashboards, Alder Creek Reservoir, Texas Hill Reservoir, and Capps Crossing Reservoir are coarsely modeled to fundamentally test availability to meet locally unmet demands. When selected in the SVM, these alternatives simply “route” additional water into Sly Park Reservoir, thereby offsetting associated demand shortfalls.

Since these drought impact mitigation alternatives are not currently being implemented with the exception of water conservation, none have been included in developing the drought triggers and response policies that have been previously presented. As shown in Appendix G, these projects do increase EID’s delivery reliability and decrease the number of times a drought is called and its duration, by varying degrees. Under the general global warming trend, the drier, cooler (less warm) climate conditions (versus the warmer, wetter conditions), some projects increase EID reliability. Still, drought is declared much more frequently. Background information on climate change factors can be found in the information box. A screen shot shown in Figure 2-3 from the SVM displays EID reliability under 2030 demands, worst-case climate change and the PL101-514, Water Conservation, and White Rock Diversion drought impact avoidance projects.

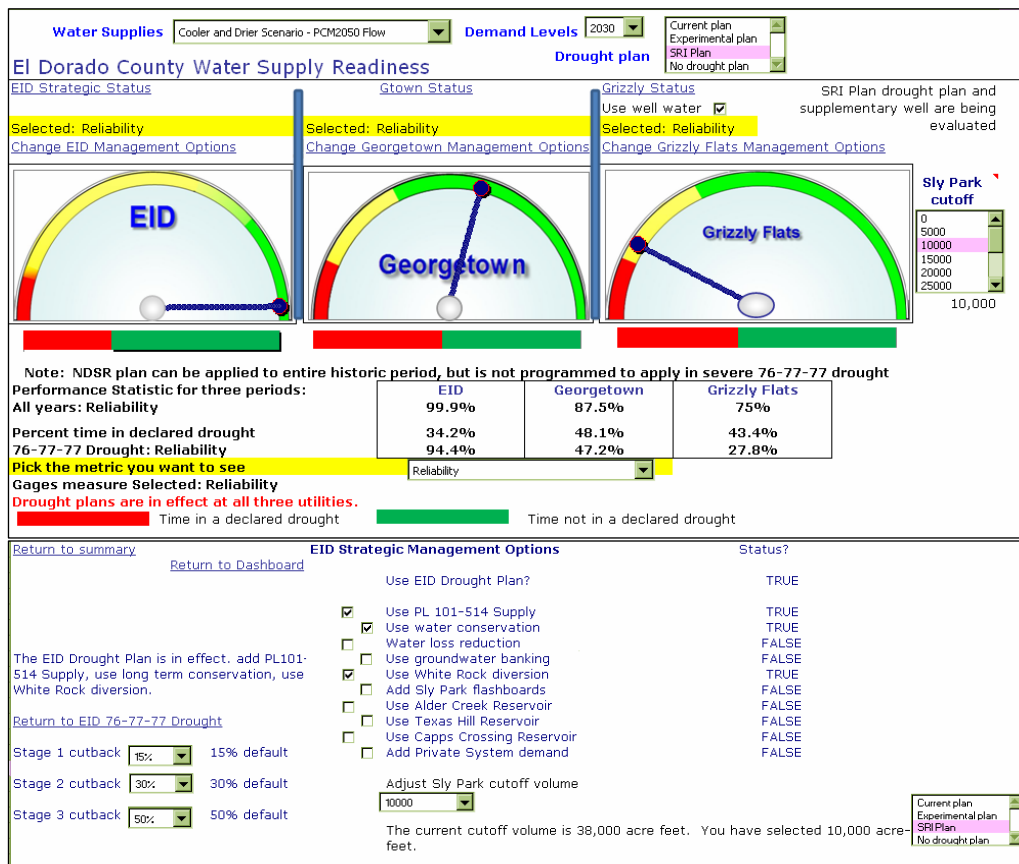


Figure 2-3. SVM Screen Shot of Regional 2030 Conditions with Worst –Case Drier, Year 2100 Scenario Climate Change and EID Drought Mitigation Projects: PL 101-514, Water Conservation and White Rock Diversion

EL DORADO IRRIGATION DISTRICT DROUGHT PREPAREDNESS PLAN

3. DROUGHT PREPAREDNESS PLAN IMPLEMENTATION

Section 3 provides guidance on the actions necessary for implementation of the Plan. The implementation plan includes recommendations for immediate consideration by the Board of Directors and actions to be completed during both non-drought periods and during each stage of drought. Plan action items are grouped under the following headings:

- Public Information and Outreach
- Interagency Drought Coordination
- Reconciliation with Existing EID Board Policy and Administrative Regulation
- Initial Implementation Actions
- Ongoing Actions – Drought Stage Zero
- Drought Stage 1 Actions
- Drought Stage 2 Actions
- Drought Stage 3 Actions

3.1 Public Information and Outreach

Public information and outreach is an important element of the EID Plan because the customer response to drought will ultimately dictate the amount of water savings achieved. EID's Strategic Management and Communications (SMAC) department will lead public information and outreach efforts in close coordination with other departments at EID. Interaction with the public will require a two way dialog. EID will share information and provide guidance to its customers. Of equal importance, EID will need to monitor the customer response and attitude toward both voluntary and mandatory customer response guidelines.

EID customer outreach is required to successfully achieve targeted water savings during each drought stage. As discussed in Section 2.3 (Drought Response), the EID drought team has recommended a drought response approach centered on voluntary compliance during drought Stage 1 and Stage 2, with mandatory restrictions implemented during Stage 3 and a mandatory phase in Stage 2. EID's SMAC department will need to effectively communicate information on drought stage, targeted water savings, and water saving guidelines that customers are expected to practice. Example materials to support public outreach are included in Appendix J.

Information on drought stage can be easily communicated using graphical output from the Drought Status SRI model as shown in Figure 2-2. The dashboard format was developed for EID in anticipation of other important EID information being communicated in a similar manner. Water savings guidelines for periods of non-drought and for each drought stage are included in Section 2.3 and Appendix H. Prior to drought stage declaration, EID will pursue outreach to inform customers of drought stages and definitions, targeted water savings for each drought stage, guidelines that customers are to follow during each stage, and sources of current information on EID drought status.

Water savings guidelines are predicated on being equitable across the various customer account types. Maintaining a sense of fairness will help achieve community participation. It is anticipated that EID customers will be provided various methods to communicate questions and provide comment to the EID.

3.2 Interagency Drought Coordination

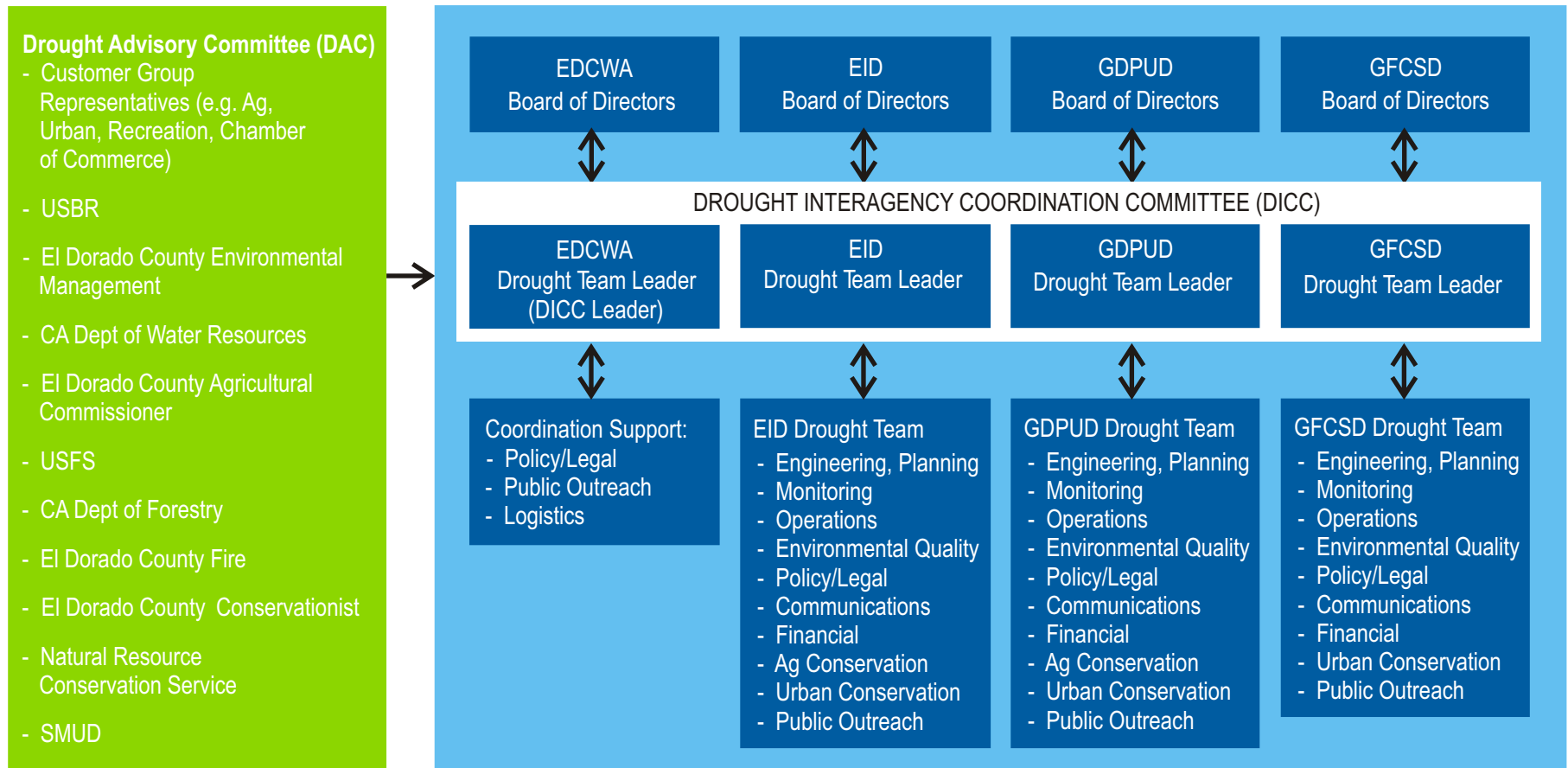
An interagency organizational framework is needed to facilitate drought coordination. Figure 3-1 depicts the suggested interagency organizational structure. Participating agencies include EID, EDCWA, GFCSD, and GDPUD. The organizational structure includes the following representation:

- **Board of Directors:** Final decision-making authority rests with each participating agency's Board of Directors. Status reports will be provided to the Board of Directors through information provided by the Drought Team Leader. The Board of Directors for each agency is encouraged to provide guidance consistent with the needs of their customers while pursuing opportunities for interagency collaboration and resource sharing.
- **Drought Interagency Coordination Committee:** Committee members will include the designated Drought Team Leader from EID, EDCWA, GDPUD, and GFCSD. The DICC is responsible for coordination activities for monitoring, public outreach, and resource sharing. The committee will also identify and recruit participation on a DAC when needed. The EDCWA representative will serve as the leader of the DICC.
- **Drought Team Leader:** Each participating agency will designate a Drought Team Leader. The Drought Team Leader will serve as the agency's liaison with the other agencies as a member of the DICC. The team leader will also be the agency point-of-contact with DAC members. The Drought Team Leader will also work closely with department staff from within EID.
- **Drought Advisory Committee:** The DAC will include representation from agencies and individuals whose input will promote efficient and coordinated drought management activities. The DAC members will provide input and suggestions to the DICC. Figure 3-1 includes the suggested membership for the DAC.

Interagency drought coordination will require varying levels of engagement dependant upon current drought conditions. The level of interaction will increase in parallel with increasing drought severity. However, preparatory and proactive coordination will continue even during periods of non-drought. Interagency coordination will center on:

- **Monitoring:** Interagency communication of drought indicator status will allow each agency to understand current conditions for other water purveyors.
- **Public outreach:** Interagency development of drought education tools plus collaboration on public education and awareness will provide efficiency and consistency across the county.
- **Resource sharing:** Interagency collaboration and coordination of resources which may include staff, grant funding, monitoring tools, infrastructure, water, and educational outreach tools will allow agencies to provide support to others in the community.

Figure 3-2 depicts the type and frequency of interagency coordination activities that will be pursued by the DICC.



BROWN AND CALDWELL	PROJECT	130868	SITE	El Dorado Irrigation District, California	Figure 3-1
	DATE	10-25-07	TITLE	Drought Interagency Organizational Structure	

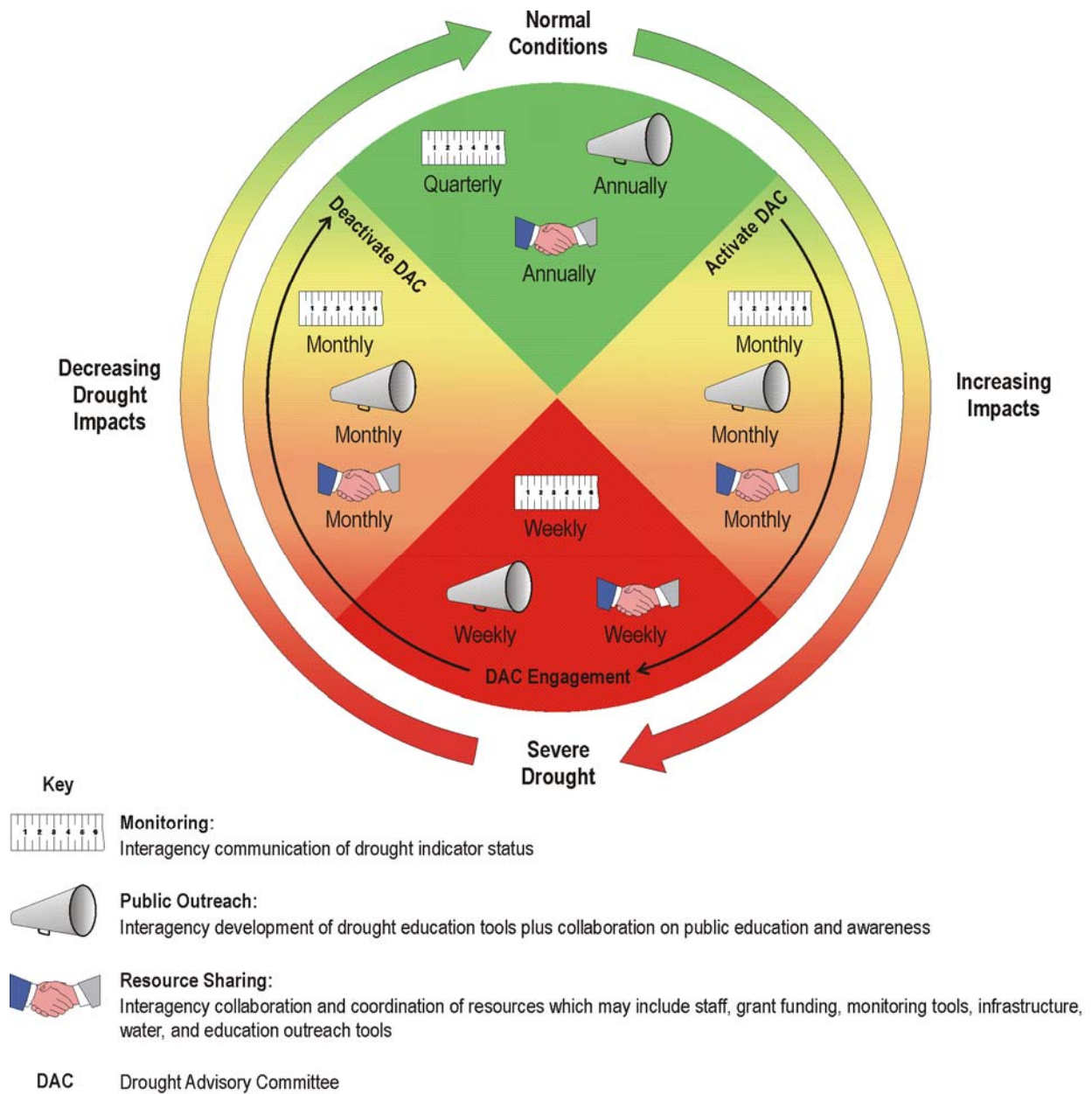


Figure 3-2. Drought Interagency Coordination Committee Activities

3.3 Reconciliation with Existing EID Board Policy and Administrative Regulation

Implementation action: Board consideration of modification of existing AR 5011 (found in Appendix C) to gain consistency with Plan elements.

Background: The EID Board of Directors has recently updated policies addressing water supply shortage and drought conditions. Existing BPs and ARs were reviewed to assess if adoption of the Plan will result in conflicts.

The Board adopted BP 5010 Water Supply Management, including AR 5011 Water Supply Management, and BP 5040 Drought Preparedness and Climate Variability as shown in Appendix C. As described in AR 5011, EID uses the 4-Stage Matrix to manage water supply during periods of drought, as included in Appendix D. AR 5011.1 through AR 5011.5 describe five water supply management conditions (or stages) ranging from Condition 1 – Normal or Unrestricted Water Supply to Condition 5 – Declared Water Shortage Emergency.

Adoption of the EID Plan is consistent with and supports BP 5040 Drought Preparedness and Climate Variability. Additionally, the Plan content is consistent with policy established under BP 5010.

Modification of AR 5011 is needed with adoption of the Plan. Inconsistencies between the Plan content and AR 5011 content exist in the following areas:

Drought stages: EID AR 5011 Water Supply Management describes the 4-Stage Matrix as the current tool to monitor and manage water shortage, including a description of the five water supply management conditions. As described in Section 2.1, three drought stages are proposed. The main rationale for adoption of a 3-stage plan is to allow time for drought response measures to be effective and reduce the potential for moving between drought stages faster than EID customers can reasonably respond to achieve the desired demand reduction. Drought stages are included in Table 3-1.

Drought indicators and triggers: EID's current tool relies on monthly Sly Park Reservoir water level elevations as the "indicator" of water shortage. Water level elevation stage triggers are established, by calendar month, for each of the four stages. EID's Drought Status SRI Model (found in Appendix A) calculates the upcoming month's drought status based on projected monthly demand and inflows, actual EID reservoir levels at Sly Park, Echo Lake, Lake Aloha, Silver Lake, and Caples Lake, current ENSO episode, current DWR water year type, and the current month's drought status.

Drought stage response measures: Currently, drought response measures are described in general terms for each of the four stages. Demand reduction actions are coordinated with drought stage water supply conditions. Drought responses recognize the extensive end uses of water related to customer class and water source (potable, recycled, raw), the method of achieving effective water reductions, and reduction policy enforcement methods. Shown in Table 3-1, drought response includes an introductory phase – Stage 1 drought – during which all customers are informed of drought and total customer demand reduction is targeted for up to 15 percent. At Stage 2 water use decisions continue to be entrusted to the customer as long as the overall water use reduction goal of up to 30 percent is met (Voluntary/Honor System). If that fails, then a Stage 2 Mandatory Phase is implemented. A strict allotment approach is implemented with a stiff penalty rate is implemented in Stage 3 with a total demand reduction goal of up to 50 percent.

Table 3-1 Drought Stage Response Summary			
Water supply conditions	Drought stage	Objective	Demand actions
Normal 0% Total Supply Reduction	Drought Stage Zero - Ongoing Conservation. Water waste prohibition in effect	Public awareness	Normal actions
Slightly Restricted Water Supplies (below normal) Up to 15% Total Supply Reduction	Drought Stage 1 – Introductory Stage. Voluntary reductions in use	Initiate public awareness of predicted water shortage and encourage conservation	Encourage voluntary measures to decrease “normal” demand up to 15%
Moderately Restricted Water Supplies Up to 30% Total Supply Reduction	Drought Stage 2 – Voluntary Phase for water use reductions and potential subsequent Mandatory Phase with restrictions on use	Increase public understanding of worsening water supply conditions, encourage voluntary conservation measures, and enforce some mandatory conservation measures	Encourage some voluntary measures and enforce mandatory measures and implement water rationing to decrease “normal” demand up to 30% Drought surcharge enacted (potential in-house trigger and board action)
Severely Restricted Water Supplies Up to 50% Total Supply Reduction	Drought Stage 3 – Mandatory restrictions (severe prohibitions) on use	Ensure that water use is limited to health and safety purposes	Enforce extensive restrictions on water use and implement water rationing to decrease demand up to 50% of “normal” demand

3.4 Initial Implementation Actions

Initial actions focus on beginning implementation of the Plan. The objective of the initial implementation actions is to complete the steps necessary to begin implementation of the Plan. Initial implementation actions are described in Table 3-2. The *Interim Agreement to Amend Terms and Conditions of the El Dorado Irrigation District Improvement District No. 97* can be found in Appendix K.

Table 3-2. Initial Drought Preparedness Plan Implementation Actions

Policy and regulation	
1.	Board consideration of policy and regulation revision as described in Section 3.1
2.	Designate EID Drought Team Leader
3.	Develop and adopt a Water Waste Prohibition (see Appendix I for example)
4.	Finalize the Draft Drought Ditch Operation Guidelines as shown in Appendix E
5.	Develop procedure for monitoring and response to compromised potable water quality during drought
6.	Develop procedure for monitoring and response of recycled water operations during drought
7.	Develop procedure for customer reporting of water waste
8.	Meet and confer with ID97 representatives to consider amending Paragraph 10 of the <i>Interim Agreement to Amend Terms and Conditions of the El Dorado Irrigation District Improvement District No. 97</i> , with the objective of modifying Paragraphs 2 and 3 to reference this successor document rather than the <i>4-stage Water Supply Matrix</i> .
Monitoring	
1.	Designate staff responsible for maintenance and reporting of Drought Status SRI Model
2.	Designated staff gains necessary familiarity with Drought Status SRI Model
3.	Drought monitoring with Drought Status SRI Model is initiated

Table 3-2. Initial Drought Preparedness Plan Implementation Actions

4.	Initiate interagency communication of drought indicator status
Public outreach	
1.	Communicate Drought Preparedness Plan adoption with community
2.	Initiate education on Drought Preparedness Plan content
3.	Coordinate with Drought Team Leader on use of Drought Status SRI Model to support public outreach
Resource management	
1.	Initiate interagency collaboration and coordination of resources through the Drought Interagency Coordination Committee
2.	Finalize strategy for coordination of WEAP climate change model with Drought Preparedness Plan

3.5 Ongoing Actions – Drought Stage Zero

Ongoing Drought Preparedness Plan implementation actions will be completed both during periods of non-drought and drought periods. These activities can be characterized as proactive actions that prepare for drought through monitoring, public outreach, and resource management practices. The ongoing implementation actions were developed by the drought plan team as described in Section 2.3. Ongoing activities are described in Table 3-3.

Table 3-3 Ongoing Drought Preparedness Plan Implementation Actions

Policy and regulation	
1.	Review and update Drought Preparedness Plan every 5 years or as needed based on new supply, operational changes, or change in expected water demand
2.	Enforce water waste prohibition (see Appendix I)
3.	Continue conservation policies and support water-efficient plumbing codes
4.	Continue and advance IMS program
5.	Review and refine rate stabilization policy relating to drought impacts every 5 years
6.	Understand and comply with legal and regulatory requirements for drought management
7.	Suggest Domestic Irrigation customers have a water conservation plan on file with EID and update this plan every 5 years
8.	Suggest AMI customers not participating in the IMS program have a water conservation plan on file with EID and update this plan every 5 years
Monitoring	
1.	Run Drought Status SRI model quarterly to assess drought status with updated demand and supply information
2.	Monitor system demands for consistency with SRI model assumptions
Public outreach	
1.	Develop and maintain drought awareness and public education materials, tools, and protocol
2.	Continue water efficiency programs
3.	Develop website link for “Drought Stage” information
Resource management	
1.	Maintain interagency coordination annually
2.	Confirm and maintain commitment of DAC members

Table 3-3 Ongoing Drought Preparedness Plan Implementation Actions

3.	Pursue development of drought impact avoidance projects (see Section 2.4)
4.	Establish and maintain trucking contracts for water hauling
5.	Construct and maintain tap manifolds for emergency water distribution through hydrants
6.	Establish procedure by which residents within EID on wells apply for emergency relief

3.6 Drought Stage 1 Actions

Drought Stage 1 actions are intended to initiate public awareness of predicted water shortage and encourage conservation. Stage 1 actions target a 15 percent demand reduction through implementation of voluntary measures. Stage 1 actions are described in Table 3-4.

Table 3-4. Drought Stage 1 Actions

Policy and regulation	
1.	Implement Stage 1 water shortage response measures (see Section 2.3)
2.	Drought Team Leader provides monthly updates on drought status to EID management
3.	EID management provides monthly updates to Board
Monitoring	
1.	Assess current drought stage monthly using Drought Status SRI Model with current demand and supply information
2.	Consider potential future hydrologic conditions in Drought Status SRI Model
3.	Monitor water demand monthly to assess water savings accomplished under voluntary measuring
Public outreach	
1.	Initiate community-oriented drought awareness with focus on community water use reduction goals and range of voluntary steps to accomplish savings
2.	Reacquaint customers with EID's Water Waste Prohibitions and introduce Stage 1 recommended water shortage response measures
3.	Provide monthly updates to public on current drought stage using the Drought Status SRI Model dashboard
4.	Provide monthly updates to public on community demand response status
Resource management	
1.	Monthly DICC meetings
2.	Confirm commitment by DAC members

3.7 Drought Stage 2 Actions

Drought Stage 2 is intended to increase public understanding of worsening water supply conditions. When EID water supplies are moderately restricted, with a reduction in supply of up to 30 percent, drought Stage 2 with voluntary, community-oriented reductions and potentially mandatory restrictions on use is enacted. If the Stage 2 Voluntary Phase approach is not effective or becomes unfair to too many customers, then the Stage 2 Mandatory Phase will be implemented. Stage 2 activities include a continuation of activities described under the Stage 1 actions and the Ongoing actions. Stage 2 actions are described in Table 3-5.

Table 3-5. Drought Stage 2 Actions	
Policy and regulation	
1.	Implement Stage 2 water shortage response measures (see Section 2.3), including a continuation of relevant Stage 1 actions
2.	Drought Team Leader provides weekly updates on drought status to EID management
3.	EID management provides at least monthly updates to Board
4.	EID management provides the Board of Directors with an assessment of the need to enact a drought surcharge
Monitoring	
1.	Assess current drought stage twice monthly using Drought Status SRI Model with current demand and supply information
2.	Consider potential future hydrologic conditions in Drought Status SRI Model
3.	Monitor water demand weekly to assess water savings accomplished under voluntary measuring
Public outreach	
1.	Accelerate community-oriented drought awareness with focus on community water use reduction goal and range of voluntary steps and mandatory requirements to accomplish savings
2.	Reinforce with customers the EID Water Waste Prohibitions and Stage 2 voluntary and mandatory recommended water shortage response measures
3.	Customers are informed that individual meter records will not be audited or fees levied if overall water use reduction goal is achieved.
4.	Customers who can conserve more are strongly encouraged to help customers who would incur economic hardship if they met the water use reduction goal.
5.	Provide weekly updates to public on current drought stage
6.	Provide weekly updates to public on community demand response status
Resource management	
1.	Weekly DICC meetings to coordinate on monitoring, public outreach, current status, and opportunities for resource sharing
2.	Enact participation by DAC members

3.8 Drought Stage 3 Actions

The objective of drought Stage 3 actions is to reduce water demand by up to 50 percent through effective and consistent public outreach, the enforcement of extensive restrictions on water use, and implementation of water rationing. Protection of water supply for public health and safety purposes is the primary objective during Stage 3 drought conditions. Drought Stage 3 actions are described in Table 3-6.

Table 3-6. Drought Stage 3 Actions

Policy and regulation	
1.	Implement Stage 3 water shortage response measures (see Section 2.3), including a continuation of Stage 1 and Stage 2 actions
2.	Drought Team Leader provides weekly updates on drought status to EID management
3.	EID management provides the Board of Directors with an assessment of the need to enact a drought surcharge
4.	EID management to provide recommendation to the Board of Directors on increasing the frequency on residential meter reading to monthly for accelerated assessment of demand reduction
Monitoring	
1.	Assess current drought stage monthly using Drought Status SRI Model with current demand and supply information
2.	Consider potential future hydrologic conditions in Drought Status SRI Model
3.	Monitor water demand weekly to assess water savings accomplished
Public outreach	
1.	Accelerate community-oriented drought awareness with focus on community water use reduction goals, range of voluntary steps, and mandatory requirements to accomplish savings
2.	Reinforce with customers the EID Water Waste Prohibitions and Stage 3 mandatory water shortage response measures
3.	Provide weekly updates to public on current drought stage
4.	Provide weekly updates to public on community demand response status
5.	Continue with procedure for customer reporting of water waste
Resource management	
5.	Weekly DICC meetings to coordinate on monitoring, public outreach, current status, and opportunities for resource sharing
6.	Continue participation by DAC members
7.	Coordinate and schedule water hauling as needed
8.	Implement and monitor tap manifolds for emergency water distribution through hydrants as needed

EL DORADO IRRIGATION DISTRICT DROUGHT PREPAREDNESS PLAN

4. REFERENCES

Brown and Caldwell. El Dorado County Western Slope Drought Analysis - Phase 1 Report. April 2006.

Department of Water Resource Water Plan Update 2005. Volume 4 – Reference Guide. 2005.

El Dorado Irrigation District. Water Supply Master Plan – Administrative Draft. December 2001.

El Dorado Irrigation District. 4-Stage Water Supply Matrix and Water Shortage Response Measures. 1995.

ENSO data from NOAA -

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.s.html

Mead and Hunt, Joint Benefit Investigation Plan: Technical Analysis for Preliminary Alternatives Prepared for El Dorado County Water Agency, El Dorado Irrigation District, Sacramento Municipal Utility District, and Georgetown Divide Public Utility District. July 2004.

Snow water content from California Department of Water Resources, ECS Station in Placerville

http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=ECS

APPENDIX A

Shared Vision Model

Drought Status Supply Remaining Index Model

Model Help Resources

See enclosed CD.

APPENDIX B

Water Evaluation and Planning Decision Support System Draft Report

**A Physically-Based Approach to Drought
Planning and Climate Change
for the EI Dorado Irrigation District**

Report

Prepared For:
The EI Dorado Irrigation District

Prepared By:
David Yates and David Purkey



October 2007

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Summary

The Water Evaluation and Planning (WEAP) decision support system (DSS) is applied to the watersheds of the South Fork of the American River and the tributaries of the Sly Park Reservoir in an application for the El Dorado Irrigation District (EID) of Northern California. WEAP is a water-centric modeling framework that provides a seamless integration of a watershed's surface and sub-surface hydrology, its consumptive and non-consumptive demands, and its water management infrastructure and governance which together determine how water is allocated throughout the watershed of interest. This is in contrast to the traditional water planning model that begins with streamflow, and therefore does not readily lend itself to mass balance closures since there is no explicit accounting of the accretions and depletions occurring throughout the watershed.

In addition to a watershed hydrology model, a demand model of the EID system was developed in WEAP, patterned off EID's recently developed Shared Vision Model (SVM) to help evaluate the robustness of EID's new Drought Plan under various future assumptions. The watersheds that contribute to the water supply of the EID were subdivided into numerous catchments and urban demand centers in an attempt to adequately characterize the forces that act on water throughout their service area. A weekly climate time series from 1980 to 2000 was used to calibrate the distributed hydrologic model within WEAP, simulating runoff into streams and reservoirs, diversions into canals and tunnels, water temperatures in the main tributaries, and the main water demand centers. Results show that the model was capable of reproducing both local and regional water balances for the 20-year period, including managed and unmanaged streamflow, reservoir storage, agriculture and urban water demands, and the allocation of ground water and surface water supplies.

Regional climate change projections were developed based on a Bayesian statistical algorithm that generates Probability Density Functions (PDF) of temperature and precipitation change. Information derived from the Bayesian model is passed to a statistical downscaling method called K-Nearest Neighbor (KNN) that also yields frequencies of future climate but at daily timescales, suitable for use in the WEAP hydrologic model. Together, the Bayesian and KNN algorithms were used to generate 10 future climate change scenarios that exhibited a warming trend over the American River basin of around 1.0 to 1.3 °C by 2030, and a set of near "average" and below average precipitation trends. In addition, the KNN algorithm was used to randomly embed a 3-year drought event into each 30 year scenario.

Given that the WEAP EID model was prioritized to first meet instream flow requirements (IFRs), the 10 climate change scenarios suggested that supply reliability would be reduced by around 10%. The IFRs are largely maintained through releases from reservoirs in late summer, river temperatures are modestly impacted by warming suggested by the scenarios.

1 Introduction and Background

The El Dorado Irrigation District (EID) is currently undergoing an extensive exercise to develop a comprehensive drought plan. This plan will be used to *help curtail and meet demands under the driest conditions (10 percent of historical recorded flow) and help determine if the current mix of supply and demand drought management options will continue to be effective into the future. The plan includes a strategy of staged demand curtailment, with the expectation that it is financially sustainable, administratively appropriate, user-friendly, and will perform equitably for all users (commercial, residential, agricultural, and environmental).* A set of indicators, triggers, defined stages (there are three), and response actions at each stage have been defined and are summarized below.

To develop their Drought Plan, EID has invested in water resource system models to simulate facility operations under observed historic streamflows and a spreadsheet model (the Shared Vision Model or SVM) that manipulates the output of the systems model to give quantitative drought indicators, triggers, and stages necessary to develop a response strategy. While the SVM is quite comprehensive, the fact that it is based on historic streamflows and the facility operations are decoupled from the drought evaluation and response model, it might not adequately inform how streamflow, system operations, instream flow requirements, or water quality constituents (e.g. water temperature) would change as a result of significant climate change throughout the EID service area over the next 30 years. This project has sought to:

- Develop an integrated watershed hydrology/water management framework that can be run under a range of future climate scenarios, forced by climate time series and not historic streamflow records.
- Encode the same *indicators, triggers, and responses* (e.g. the Drought Plan) into that model to replicate the SVM model as closely as possible.
- Test infrastructure operating rules that are being considered as part of the Drought Plan against the simulated streamflows based on future climate scenarios and the Drought Plan,
- Evaluate the water temperature implications of these operating rules and adjust operating rules on reservoirs if simulated water temperatures rise to levels of concern.

The Water Evaluation and Planning (WEAP) model of California's El Dorado Irrigation District (EID) is an ideal analytical framework to 1) represent the indicators, triggers, and responses of the Drought Plan in a way that dynamically couples supply and demand; 2) assess the robustness of the Drought Plan to potential climate change and how the Drought Plan impacts both water resource and water quality components; and 3) consider other adaptation strategies to improve system performance within the context of the EID Drought Plan. The model can help determine if future climate

change will result in different patterns of supply and demand relative to the current situation and whether a set of potential water management adaptations can assist in reducing negative impacts or enhance benefits. This management includes adaptations to the priorities of water supply and demand management (agriculture, environmental, and urban), and how EID's infrastructure (reservoirs and diversions) might be modified or operated differently to address climate impacts. This report describes the fundamentals of the framework, most notably the Water Evaluation and Planning Version 21 (WEAP) model and its application to the El Dorado Irrigation District, with the expectation that the model framework would be used by the District to help quantify the potential gaps between water supply and use, especially in the face of climatic change.

EID has undergone an extensive exercise to try and develop a robust Drought Plan that *declares a drought early enough to maximize saved water, but not so early that false drought declarations are issued. False drought declarations can result in unnecessary revenue losses and compromised community faith in EID.* Several drought trigger-plans have been evaluated by EID, including an analysis of the “Current Plan” which is based on Sly Park reservoir levels and a 4-stage drought response; an “Experimental Plan”, which includes both local and regional storage (Sly Park and Folsom), and a regional water year type index; and a third plan referred to as the “Supply Remaining Index Trigger Plan or SRI Plan”. We have implemented the SRI plan in WEAP according to the description found in Chapter 1 of the “Drought Plan Development” of the EID Drought Plan document provided to us by EID’s Watershed Coordinate, Elizabeth Betancourt.

This SRI plan considers an estimate of the number of days of water supply remaining under a worst case assumption. When the number of days supply remaining (DSR) is low, there is a limited amount of water supply left and drought restrictions should be imposed to stretch the supplies longer. The DSR indicator incorporates expected future supply and demand, and in the SVM is calculated at the end of each month of the simulation. The WEAP model is implemented on a weekly timestep, including the implementation of the SRI Plan, which consists of the following indicators:

- Storage in Sly Park Reservoir, Echo Lake, Lake Aloha, Silver Lake, and Caples Lake;
- Worst case expected supplies - conservatively based on the minimum monthly hydrology (reservoir inflows) in the historical record (1922-2004);
- Normal (unconstrained) projected demand in the coming months. In determining the reliability under these conditions, demand projections are based on typical demand year, projected into future.

In this report, we first give an overview of the WEAP DSS framework (Section 2) and then describe how the EID system is represented within that framework, including the delineation of rivers and watersheds and the EID water supply and demand infrastructure and general operating guidelines (Section 3). This is followed by a description of how the SRI Drought Plan was implemented in WEAP and an evaluation of how it performs over the historic period of 1980 through 2003 (Section 4). We then describe the development of a set of climate change projections that are used to force the WEAP EID model (Section 5), and then evaluate the EID SRI Drought Plan in the context of those scenarios (Section 6).

2 Background on the Water Evaluation and Planning (WEAP) Model

In its original formulation, WEAP was a generic water resource systems simulation model in which exogenous information on water supply, water demand, and water regulation was used to simulate how available water should be allocated under a range of scenarios (Raskin et al. 1992). A similar approach is used in the State of California's water simulation model (CalSim-II), which is the water planning model for the Central Valley water system developed by the California Department of Water Resources (DWR) and the United States Bureau of Reclamation (USACBR). Like CalSim-II and other water resource simulation models, WEAP uses an optimization routine to determine an appropriate water allocation pattern within a given model time step as bounded by a set of simulated constraints.

Historically, Integrated Water Resource Management Models (IWRM) have tended to focus on either understanding how water flows through a watershed in response to hydrologic events or on allocating the water that becomes available in response to those events. For example, the US Department of Agriculture's Soil Water Assessment Tool (SWAT, Arnold and Allen 1993), includes sophisticated physical hydrologic watershed modules that describe, among others, rainfall-runoff processes, irrigated agriculture processes, and point and non-point water watershed dynamics, but a relatively simple reservoir operations module (Srinivasan et al. 1999; Ritschard et al. 1999; and Fontaine et al. 2002). The RiverWare™ DSS is a state-of-the-art water resource planning and hydraulics operations model, which can be used to develop multi-objective simulations and optimizations of river and reservoir systems such as storage and hydropower reservoirs, river reaches, diversions, water users, etc.; but requires upstream flows from gages or derived from a physical hydrologic model (Zagona et al. 2001).

The Water Evaluation and Planning Version 21 (WEAP) IWRM attempts to address the gap between water management and watershed hydrology by integrating physical hydrologic processes with the management of demands and installed infrastructure in a seamless and coherent manner. Within the water resource systems logic is embedded a watershed hydrology module that allows for the direct assessment

of hydrologic changes on managed water systems. This integration allows WEAP to be run, for example, with alternative climate scenarios without having to externally translate the implications of these changes into a hydrologic response. This allows for analysis of alternative and/or future climate scenarios that are unbounded by a reliance on historical hydrologic patterns. Analysis in the WEAP framework flows directly from the climate scenarios and not from a perturbation of the historic hydrology as is necessary in applying the California Water Simulation Model (CalSim-II) or the California Agriculture model (CALVIN) to the question of potential impacts of climate variation and change on the water sector (Draper et al. 2003).

WEAP can yield insights into watershed processes on a comprehensive level, including alternative climate scenarios and human impacts such as land use change, changes in municipal and industrial demands, alternative operating rules, points of diversion changes, etc. Since WEAP's allocation scheme is demand oriented, the landscape's evaporative demands and non-consumptive demands are internally estimated at each time step, which are the key drivers for water delivery. Except to meet flood control targets or instream flow requirements, releases from reservoirs are triggered by downstream demands, not by prescribed release volumes based on contracts. This makes WEAP unique as a planning study model for EID, since both supply and demand side interactions can be addressed simultaneously.

Section 2 provides a summary of the most relevant elements of the WEAP model (see Yates et al. 2005 a,b for more details), including a description of the hydrology module and how it is seamlessly integrated into the water allocation component. Section 3 describes the WEAP model of the El Dorado Irrigation District by detailing the division of the Basin into catchments and representative areas; the representation of the water infrastructure, its control and water demands; and the calibration and validation of the system in terms of both the physical hydrology and the managed water system. Finally, section 5 illustrates how the model can be used for planning purposes by reformulating the allocation priorities and the implications of climate warming on the El Dorado Irrigation District.

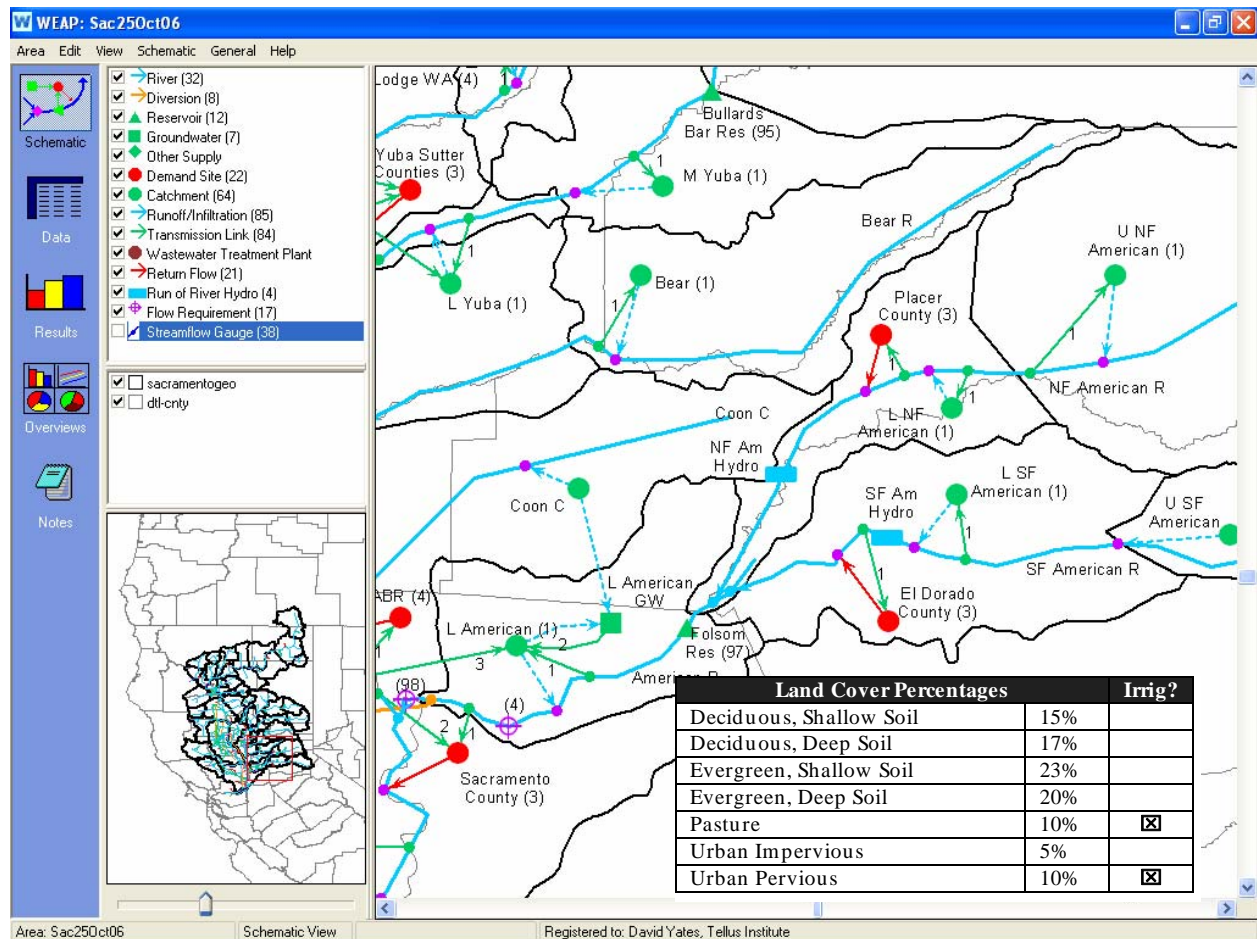
A recent round of WEAP enhancements include a seamless integration of a rainfall-runoff and groundwater hydrology modules into WEAP's existing water allocation framework (Yates et al. 2005a,b). These modules combine information on the biophysical characteristics of a catchment with climate forcing data to simulate streamflow and other terrestrial components of the hydrologic cycle, including evaporative demands and surface-subsurface interactions. In turn, estimates of the terrestrial components of the hydrologic cycle are coupled with WEAP's water allocation framework.

At each time step, WEAP computes the hydrologic flux and passes this to appropriate river and groundwater objects. A standard linear program (Berkelaar et al. 2004) solves the water allocation problem whose objective is to maximize satisfaction of

demand, subject to supply priorities, demand site preferences, mass balances, and other constraints. The constraint set is iteratively defined at each time step to sequentially consider the ranking of the demand priorities and supply preferences. (see Yates et al. 2005 for details). All flows are assumed to occur instantaneously, thus a demand site can withdraw water from the river, consume some, optionally return the remainder to a wastewater treatment plant and then return it to the river in the same time step. Thus, the model time step should be at least as long as the residence time of the study area and, for this reason, a weekly time step was used for this EID analysis. Since the unique aspect of this EID planning model is the integration of physical hydrology within the water management paradigm, we've elaborated a bit on the hydrology components of WEAP (see Yates et al. 2005 a,b for details).

A WEAP planning model is spatially oriented, with a study area configured as a set of contiguous catchments, overlaid with a network of rivers, canals, reservoirs, demand centers, and other water features. Each catchment can be sub-divided into unique fractional areas (*fa*'s) according to soil and/or land use, are not spatially located within the catchment, and must sum to 100% of the catchment's total area. An example of such a configuration is shown in Figure 1 for the Lower American River. Rivers are represented as lines and are appropriately labeled (**South Fork American River**, **North Fork American River**, etc.). The light shaded circles with attending dashed lines represent catchment's and their connection to a given river (e.g. **Upper North Fork American**, **Upper South Fork American**, etc.). A solid line returning to the catchment indicates that the catchment has irrigation requirements. Rectangles on rivers are run-of-river hydropower elements, while triangles are reservoirs (**Folsom Reservoir**, **Bullards Bar Reservoir**). The dark, shaded circles are traditional municipal and industrial demands, with connecting lines to and from a demand site indicating their supply sources and return flows, respectively. The dark squares are groundwater objects, with dashed lines from catchments (**Coon Creek** and **Lower American**) indicating they are hydrologically connected to a groundwater object (**Lower American Ground Water**). A solid lines originating from a groundwater object to a catchment or demand site indicates the groundwater is a source of supply to the given demand. The individual numbers along supply sources or at demand sites indicate the supply preference or demand priority, respectively; which are used by WEAP's allocation logic to apportion water. Generally, Priority 1 Demands are satisfied first, then Priority 2 Demands, etc. Demands that can be satisfied by multiple sources will draw first from Supply or Preference 1, then Supply or Preference 2, etc. Finally, the hatched circles on rivers represent instream flow requirements, with their priority given as the integer value within parentheses.

Figure 1. The Lower American River representation in WEAP

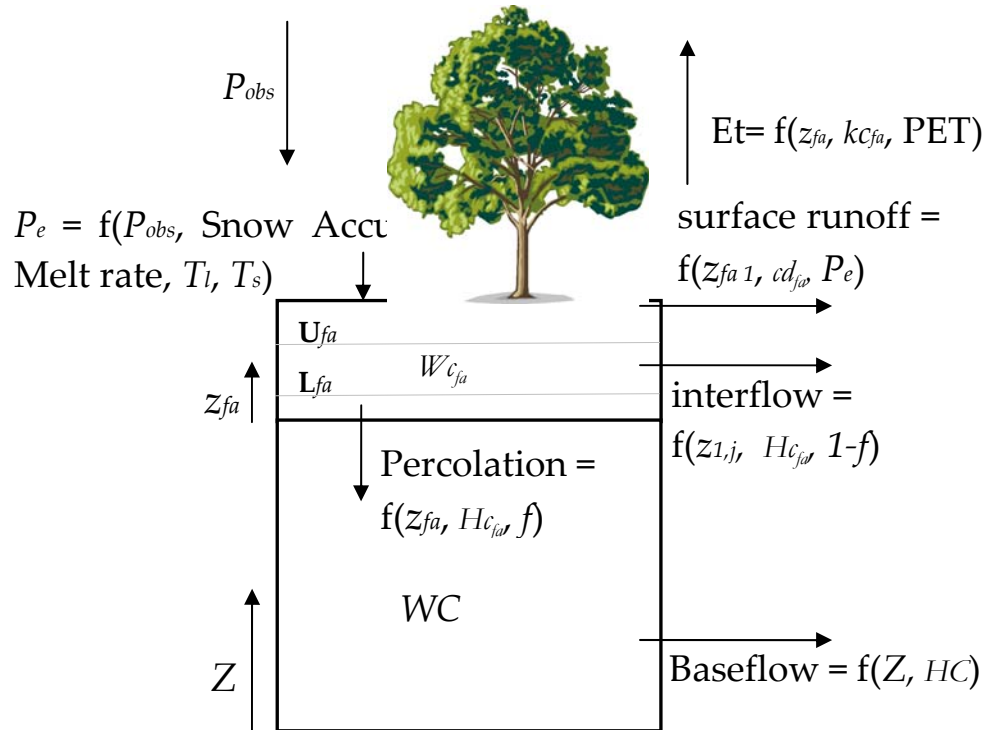


A unique climate forcing data set of observed precipitation (Pobs), temperature, relative humidity and windspeed is prescribed for each catchment. The hydrologic response of each fractional-area is depicted by a fairly traditional, one-dimensional, two-bucket, lumped parameter water balance model that tracks relative storage, z_{fa} and Z , by partitioning water into evapotranspiration, surface runoff, interflow, and baseflow (Figure 2). The sum of the fractional-areas for each catchment represents its overall hydrologic response, with the runoff components linked to a river reach, deep percolation to a groundwater aquifer unit, or evapotranspiration lost from the system.

The hydrologic model structure attempts to approximate the most important hydrologic processes using only a few key parameters, specified for each fractional area, fa (Figure 2). These include a plant/crop coefficient (kc_{fa}) that in combination with an estimate of potential evapotranspiration (PET) determines evaporative losses (Et); a conceptual canopy density (cd_{fa}) with higher values reducing rapid surface runoff (Kergoat, L. 1998, 1999; Asner et al. 2002); and water holding capacity (Wc_{fa} , mm) and hydraulic conductivity (Hc_{fa} , mm/time) which determine the slower, interflow response

and its seasonal fluctuation. A partitioning fraction, f determines whether water moves horizontally or vertically. For each catchment, a lower bucket is prescribed that includes two parameters- water holding capacity (WC , mm) and hydraulic conductivity (HC , mm/time) which influence the long, baseflow response.

Figure 2. WEAP conceptual water balance elements.



Irrigated crops can be one of many fractional areas within a catchment and thus share the same surface hydrologic model as the “natural” land covers. Irrigated land covers differ, however, in that the user can assign unique upper and lower relative storage thresholds for the upper bucket (e.g. L_{fa} and U_{fa} in Figure 2) and irrigation schedules, which together dictate the quantity, timing, and efficiency of applied irrigation. Catchments with irrigation require water sources to meet that demand and in WEAP the user associates surface and/or groundwater supplies to the appropriate catchments that contain irrigated land covers.

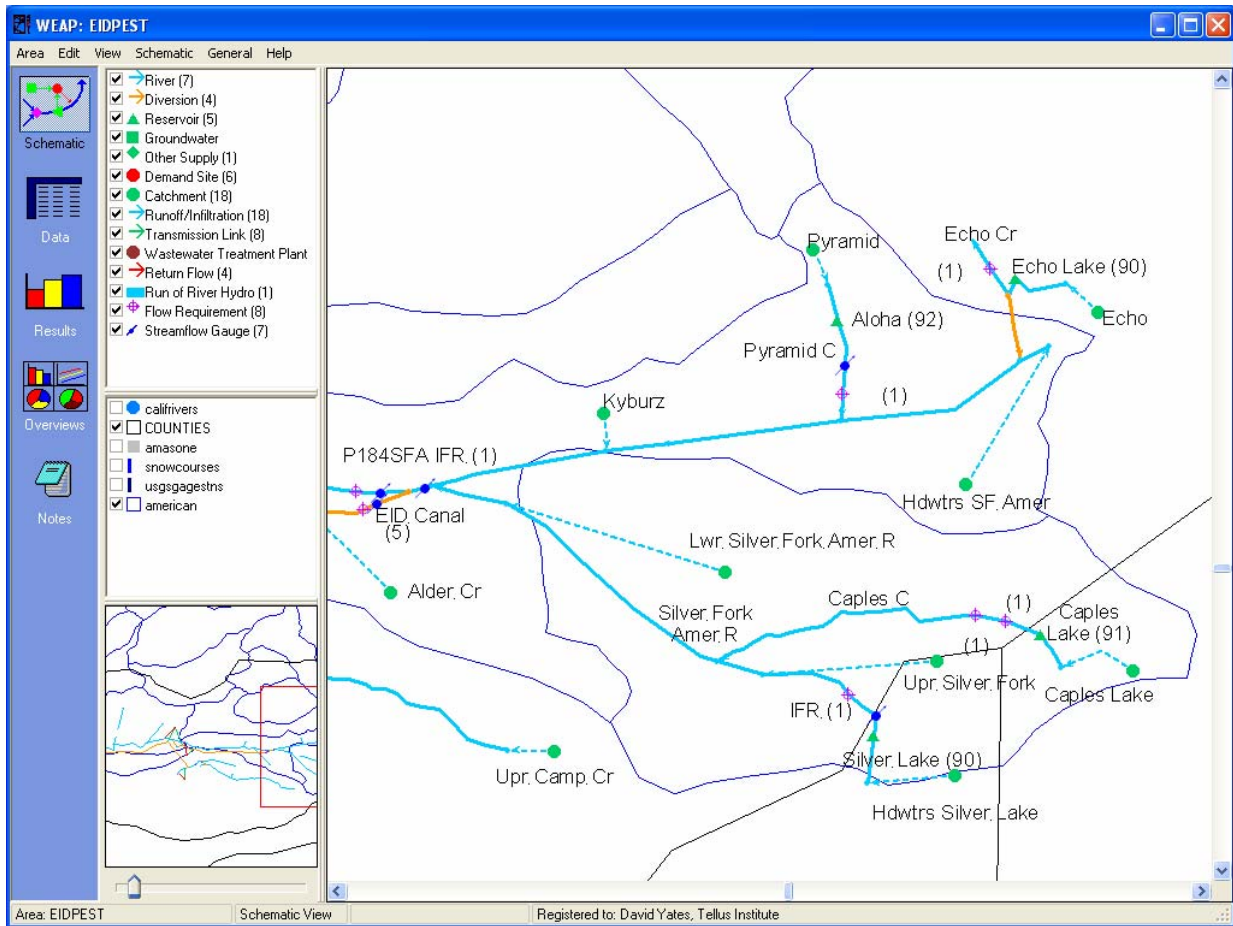
3 A WEAP representation of the El Dorado Irrigation District

The first step in developing the WEAP model of the EID system was to disaggregate the basins into representative catchments and rivers. A Geographical Information System (GIS) analysis of the United States Geological Survey’s (USGS) Hydrologic Unit Classification (HUC) eight-digit cataloging or watershed units (here, referred to as HUC8) and stream gage data were used together to disaggregate the

region into 17 representative catchments. For each catchment, the USGS 30-meter National Land Cover Data set (NLCD92) was used to identify the unique fractional-areas based on land use and cover (LULC) types including deciduous and evergreen trees, shrubs, grassland, wetlands, barren land, open water, and urban land use types. The perimeter catchments were often dominated by only a few LULC's (evergreen and deciduous trees) while some of the foothill catchments contain nearly all the LULC types. For each of the 17 catchments, a weekly climate time series was derived from gridded daily time series as an average of all grid cell values contained within the catchment (Thornton 1997). Weekly precipitation was given as the sum of the daily values. Other climate variables include temperature, and humidity each given as weekly values for each catchment. Wind speed is prescribed as a climatological average for all time steps.

The EID water supply and deliver infrastructure and a representation of EID demands were encoded into the WEAP water modeling environment (Figure 3). The 10 dots and their connecting dotted lines represent individual sub-catchments (Pyramid, Echo, Headwaters South Fork American, etc.). The four triangles are the reservoirs (Silver, Caples, Aloha and Echo), while the hatched circles are in-stream flow requirements. P184IFR is the Project 184 instream flow requirement. The EID system includes a small hydropower facility physically part of the Project 184 infrastructure. The EID water supply system operates within an increasingly stringent regulatory environment to meet water quality standards, to protect the environment, to ensure wildlife habitat, and of course to supply a clean, safe water supply to its customers. Project 184 includes several reservoirs and 23 miles of flumes, canals, and tunnels. Project 184 represents nearly 35 percent of EID's total water supply, which delivered to customers through a diversion from the South Fork of the American River near Kyburz. New guidelines under the FERC license stipulate a conditional in-stream flow requirement (IFR) on the South Fork below Kyburz, which varies between wet, above normal, below normal, dry and critically dry water years. The new requirements are an attempt to re-introduce some of the natural variability of the river system, with peak IFR's in April, May and June corresponding to the historical snowmelt season. This analysis will help to discover the impact of the new regulatory requirements mandated by the FERC license on the ability of EID to continue to use Project 184 water for hydropower production now and in the face of climatic variability, and the robustness of the Drought Plan to be able to meet those IFR's under various hydrologic conditions.

Figure 3. The South Fork of the American River and EID’s Project 184 system as represented in the WEAP DSS.



3.1 Rivers, Canals, Diversions, and Bypass Conveyances

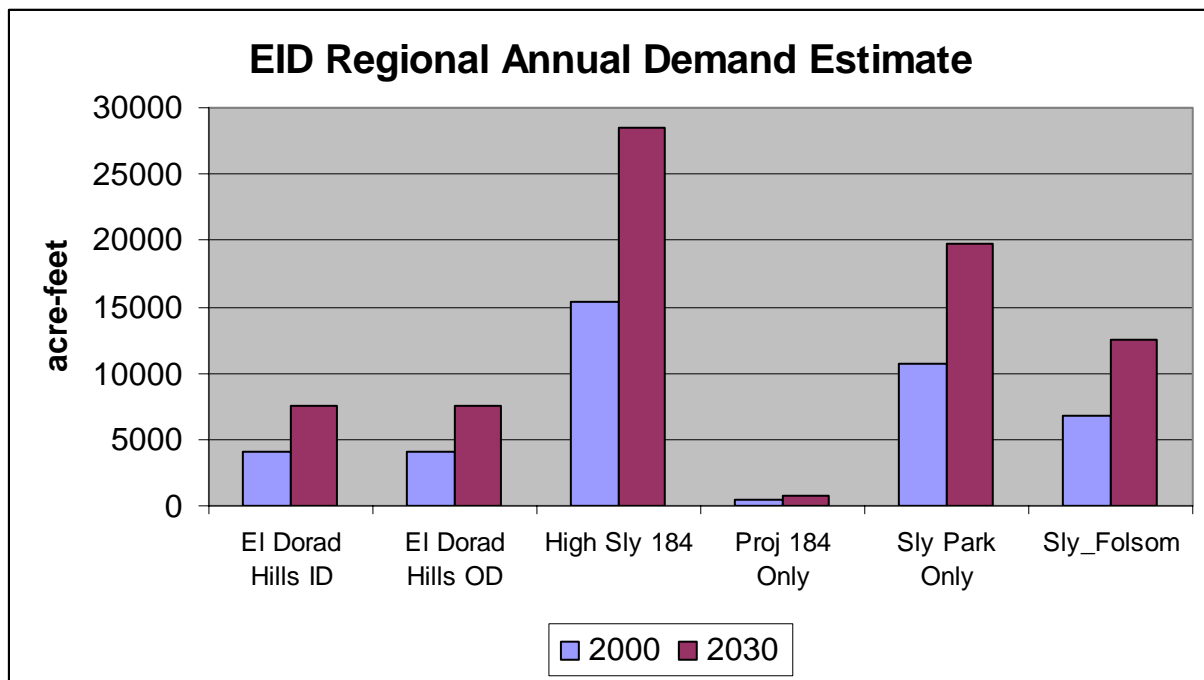
Each of the 17 catchments provides the hydrologic flux back to rivers, canals, and drains. There are several tributaries of the South Fork of the American, including the Silver Fork, Caples and Aloha. In the case of small tributaries, their contributing areas often included two to three catchments whose runoff incrementally contributes to streamflow generation. The model includes the Camp Creek diversion to Sly Park Reservoir and the Comino conduit. The Project 184 canal at the Kyburz diversion point is also included, with its attending hydropower facility as well as the Hazel Tunnel Diversion which can take excess Project 184 water available to EID and divert it to Jenkinson Lake (also known as Sly Park) if there is available storage.

3.2 Demands: Municipal, Industrial, and Environmental

The EID water demands in WEAP are represented by a series of aggregate demands that vary within the season and which grow over time based on assumptions of future growth. From east to west, these demands were disaggregated by their supply source based on information contained within the SVM model. Total “unrestricted” annual demand in Year 2000 was approximately 42,000 acre-feet, with that demand growing to nearly 80,000 acre-feet by 2030. For this study, Georgetown and Grizzly Flat demand were not included.

Total demand was disaggregated into six regions (Figure 4). To the west are El Dorado Hills (Indoor and Outdoor split equally); Sly/Folsom (demand that can be met either by Folsom Reservoir or Sly Park water); Sly Park Only (western demand that can only be met by water from Sly Park); and to the east are Proj184 Only (water delivered to EID’s eastern service area only from Project 184 water) and High Sly/P184 (demand that can be met either by Project 184 water or water from Sly Park/Jenkinson Lake depending on the availability of Project 184 water and the levels in Jenkinson Lake).

Figure 4. Total water demand estimates by region under no drought conditions (e.g. no drought stage has been declared for these 2000 and 2030 demand estimates)



3.3 Instream Flow Requirements and Diversions

The EID is required to maintain minimum streamflows below most of their major reservoir and diversions, such as Echo Creek below Echo Dam; Pyramid Creek below Lake Aloha; and others specified in a series of minimum streamflow schedules (see Condition No. 31- Minimum Instream flow requirements). The minimum streamflow schedules have been separated into five water year types: Wet, Above Normal (AN), Below Normal (BN), Dry, and Critically Dry (CD), with the type determined by the State of California’s water year type designation based on unimpaired inflow to Folsom Reservoir for the period of April through July, as set forth in Bulletin 120 (Water Conditions in California as published by the California Department of Water Resources). Water year types are defined as follows:

- Wet = greater than 125 percent of average
- AN = less than 125 percent but greater than or equal to 100 percent of average
- BN = less than 100 percent but greater than or equal to 75 percent of average
- Dry = less than 75 percent but greater than or equal to 50 percent of average
- CD = less than 50 percent of average

The month of May is used to establish the water year type for the future months, May through February of the next year, when forecasting begins again.

Table 1. Example instream flow requirement for the diversion at Kyburz.

South Fork American River Below Kyburz Diversion						
Month	Minimum Streamflow by Water Year (cfs)					
	CD	DRY	BN	AN	WET	
OCT	15	15	40	50	50	
NOV	15	18	40	50	50	
DEC	15	25	40	50	50	
JAN	15	25	40	50	50	
FEB	20	30	40	50	75	
MAR	30	60	110	110	110	
APR	60	120	180	180	180	
MAY	60	120	180	240	240	
JUNE	60	120	180	240	240	
JULY	40	85	125	160	160	
AUG	18	18	65	65	65	
SEPT	15	15	50	50	50	

In WEAP, the details of the Kybrz diversion shown in Table 1 are written in WEAP using a set of key assumptions which are entered into an instream flow requirement object that is placed below the diversion on the South Fork of the American.

There are other instream flow requirements specified in the Condition 31 document, which are represented in the WEAP model, and include instream flows below reservoirs and a spring pulse flow below Caples Reservoir. This pulse flow is meant to mimic the pre-dam era of high spring flows as a consequence of snow melt runoff (not shown).

El Dorado Canal (Kybrz Diversion) – The El Dorado diversion dam diverts water into the EID canal from the South Fork of the American as part of the Project 184 system. This diversion is mainly driven by downstream demand, but will also serve the 21-megawatt El Dorado hydroelectric power generation project.

The Hazel Tunnel Diversion - A sequence of rules was encoded in WEAP to represent the diversion logic for making use of surplus water on Project 184 from November through December. This diversion would preserve the Project 184 pre-1914 water rights, and provide a storage buffer via Jenkinson Lake (also known as Sly Park). The water may spill in February, but if a dry winter/spring occurs, then this diversion would be an added insurance against shortages. We have assumed that the diversion would only occur from 1 November through 31 December.

General Rule: The general rule is stated as: On November 1 of each year, check the storage in Jenkinson Lake. *If storage is < 20,000 AF and there is supply remaining from the 15,080 AF from Project 184 consumptive deliveries, then the remainder could be diverted through the Hazel Creek Tunnel into Jenkinson Lake at a rate of up to 50 CFS. When the volume of diversion brings the Project 184 diversions up to the 15,080 AF allowed, then turn the diversion off.*

In WEAP (references to actual variables as implemented in WEAP are abbreviated here for clarity), the expression is given as a set of conditionals, nested with a single and that all must be true for the diversion to be set at 50 cfs, else its 0

`If(And(ts>4, ts<12, PrevTSValue(Jenkinson:Storage Volume[m^3])/1233 <20,000,(PrevTSValue(Supply and Resources\to_Proj_184_Only\from_P184Only: Flow[m^3],0,1,40)/1233+PrevTSValue(Supply and Resources\Linking Demands and Supply\to_High_Sly_184\from P184High:Flow[m^3],0,1,40)/1233) <10080),50,0)`

1. The expressions **ts>4**, **ts<12**, only allows diversions to occur between time step 4 (1 Nov) through time step 12 (31 Dec)
2. **PrevTSValue(Jenkinson:Storage Volume[m^3])/1233 < 20000** Looks back at the previous weeks storage in Jenkinson, and if it is less than 20,000 acre-feet, then the condition is true. The division by 1233 is to convert from m³ to acre-feet

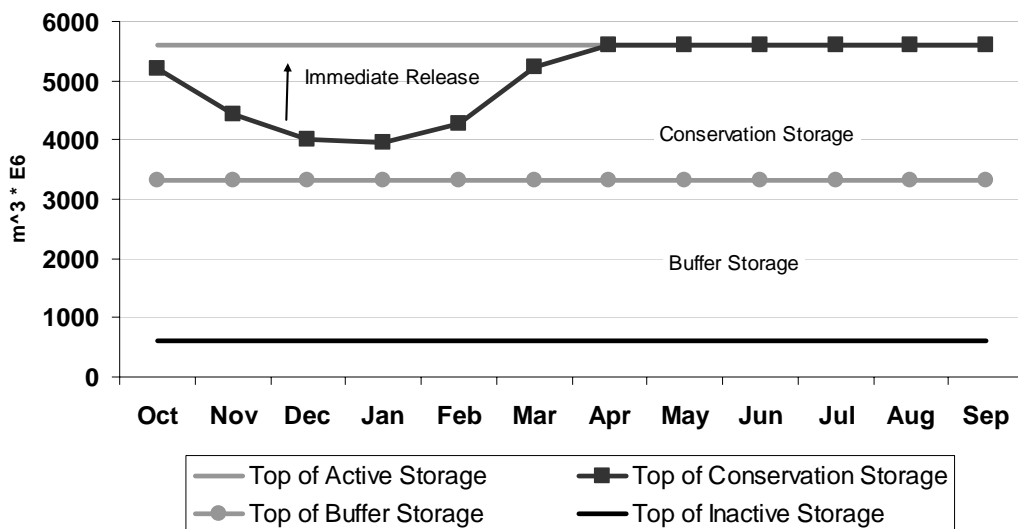
3. $\text{PrevTSValue}(\text{Supply and Resources} \setminus \text{to_Proj_184_Only} \setminus \text{from_P184Only: Flow}[\text{m}^3, 0, 1, 40] / 1233 + \text{PrevTSValue}(\text{Supply and Resources} \setminus \text{Linking Demands and Supply} \setminus \text{to_High_Sly_184} \setminus \text{from_P184High: Flow}[\text{m}^3, 0, 1, 40] / 1233) < 10080$

Sum the diversions off of the EID canal for the previous 40 months, and if their sum is less than 10,080, then this condition is true.

3.4 Reservoir Storage and System Operations

Five reservoirs are included throughout the EID system, including Aloha, Caples, Echo, Silver, and Sly Park (Jenkson Lake), which together can store about 80 thousand acre-feet (taf). These reservoirs are operated in a staggered manner over the season, and are sequentially drawn down as summer ensures to 1) meet downstream requirements and 2) maintain water in the reservoirs to meet recreational needs. Hydropower can be generated off the EID canal, but is a secondary benefit in most cases. To reflect these operational objectives, reservoir operating rules are expressed as weekly average reservoir volume thresholds (Figure 5). These include a conservation volume above which water is immediately passed downstream and within which water can be fully released to meet downstream demands. The next storage zone is called the buffer zone and defines a portion of the reservoir where downstream demands can only be met as a percentage (the buffer coefficient) of the available storage at and below the buffer zone storage. Typical buffer coefficients for each reservoir are 0.05, which means a maximum of five percent of the current storage can be used to meet demands in a single time step. Finally, inactive storage cannot be used to meet demands.

Figure 5. Physical and operational “pools” used to describe reservoirs in WEAP.



Targeted lake levels and minimum pools are described in Condition 52. An example descriptions for Silver Lake states that “.. the licensee shall not release prior to Labor Day of each year water from Silver Lake for consumptive use, power production, re-diversion, maintenance, or other purposes, excluding any non-discretionary releases required by FERC or the State Division of Safety of Dams”, while targeted lake levels for Caples Lake are given as a set of targeted lake levels by water year type (Table 2).

Table 2. End-of-month lakes levels by water year type for Caples Lake.

Caples Lake						
		End of Month Lake Levels by Water Year				
Month		In Acre-Feet				
		CD	DRY	BN	AN	WET
JUNE		18704	18704	22338	22338	22338
JULY		18413	18646	22089	22338	22338
AUGUST		14376	14376	18006	18006	18006
SEPT		14376	14376	18006	18006	18006

These targeted levels and release priorities are entered in WEAP as a set of key assumptions in the Reservoir Operations modules for each lake object, and as a sequence of Fill Priority values for each reservoir. The reservoirs of the Project 184 system include Aloha, Caples, Silver, and Echo. Aloha has the lowest fill priority value (92), which means it will be used first to fulfill downstream demand, Caples has the next highest fill priority value (91) and will be used next, and finally Echo and Silver have the highest fill priority (90) and will be spilled last. Jenkinson Lake is not within the South Fork of the American drainage and is not part of Project 184, and was assigned a low fill priority of (94), meaning a high priority to take water from this reservoir to meet downstream demands.

3.5 Hydrologic and Water Resource Calibration and Validation

We used the model independent, non-linear parameter estimation software PEST® (Doherty 2002) to calibrate the hydrologic component of the WEAP EID model based on the naturalized flows on the South Fork of the American near Kyburz. A 20 year period from 1980 to 2000 was used in the calibration and validation procedure based on a split sample (1982 to 1992 for calibration and 1993 to 2000 for validation). PEST automatically adjusted a set of scaling parameters including H_{Cfa} , k_{Cfa} , HC , W_{Cfa} , cd_{fa} , and absolute values of T_l , and T_s until the simulated and observed inflows more closely matched, in a weighted least squares sense. Figure 6 is the average weekly flow for the calibration and validation series, and shows that the model adequately reproduced flows near Kybrz quite well. The validation series tends to overpredict the

high flows in the spring. The validation series also includes the extreme Week 1, January of 1997.

Figure 6. Modeled and observed flows near Kyburz for both the calibration and validation period.

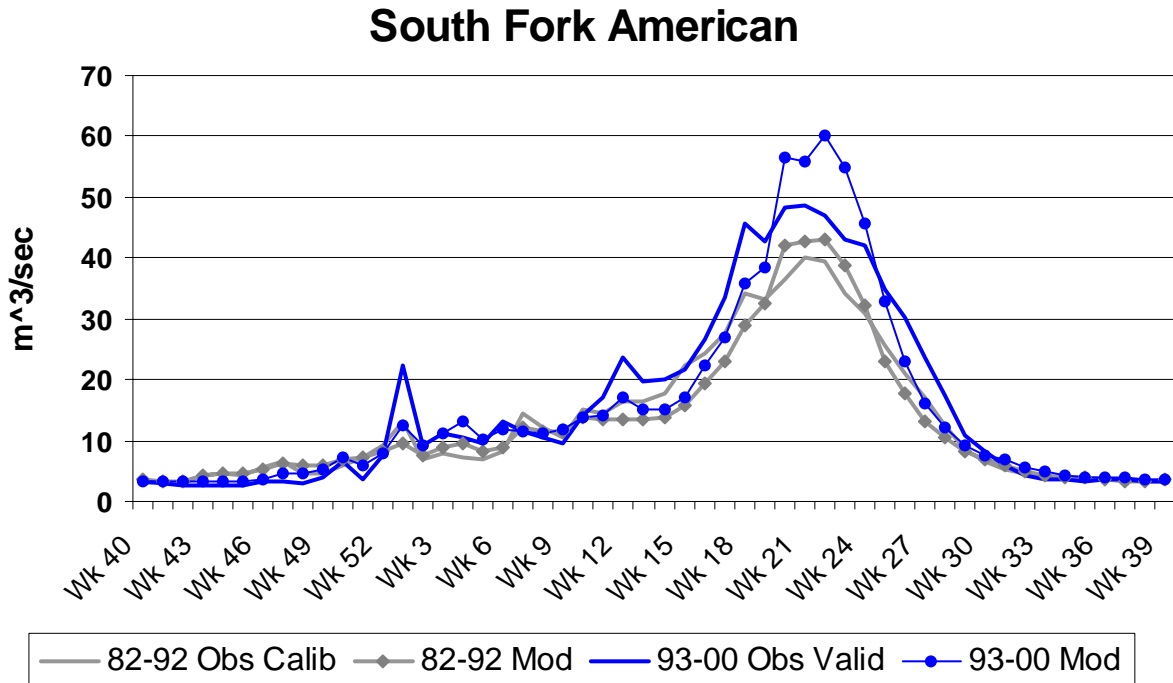
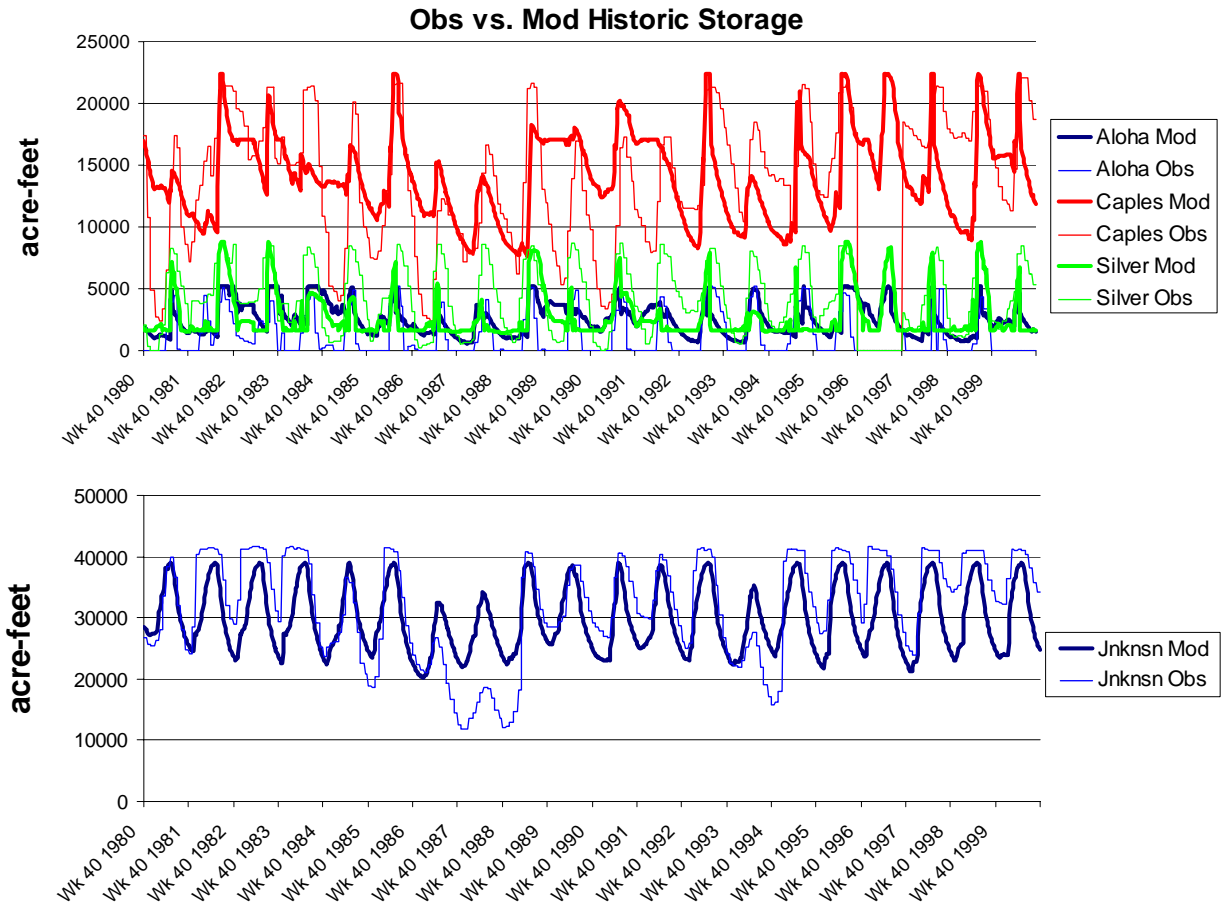


Figure 7 shows modeled and observed reservoir storage from 1980 through 2000. The WEAP was capable of capturing the general trends, but at times over or under estimated reservoir storage. The observational record of reservoir storage suggests some substantial operating changes over the period. Note, for example, the dramatic draw down of Caples Lake from around 1984 through 1992, while this variability is not as great in the late 1990's. Likewise, for Jenkinson Lake, the model tended to over estimate drawdown in "normal years", especially during the late 1990's when the observational record suggests modest releases, while releases were more substantial around 1987 and 1988. Also for Jenkinson Lake, the model did not replicate the strong draw-down of the reservoir in 1988 and 1989, which suggests that there are other downstream requirements on the reservoir, other than EID, that draw water from this reservoir particularly in drought years. This is an issue that needs resolving with EID staff.

Figure 7. Modeled vs. Observed reservoir storage from 1980 through 2000.



4 Implementing EID's SRI Drought Plan in WEAP

The EID has developed a robust plan that incorporates several indicators and triggers to increase EID's system reliability. A summary of the Supply Remaining Index plan is given below, taken from the "Drought Plan Development" document provided to us by EID. A key component of the SRI drought trigger plan is a measure of the number of days supply remaining (DSR). When the DSR is low, there is a limited amount of water supply left and drought restrictions should be imposed to stretch the supplies longer. The DSR indicator incorporates expected future supply and demand, and using the SVM, calculates the DSR for each month of the simulation. The DSR indicator is calculated based on:

- Current storage in Sly Park Reservoir, Echo Lake, Lake Aloha, Silver Lake, and Caples Lake;
- Worst case expected supplies - conservatively based on the minimum monthly hydrology (reservoir inflows) in the historical record (1922-2004); and

- Normal (unconstrained) demand in the coming months - projected demand by month. In determining the reliability under these conditions, demand projections are based on a modeled demand year.

The DSR indicator is not the actual number of days of supply remaining, since it considers the historically worst inflows rather than probable inflows. Using probable inflows would increase the estimate of days supply remaining. From the DSR, a days supply remaining index (SRI) is computed, based on the number of days supply remaining for 20 months into the future, and estimates the specific day shortfall occurs. The SRI represents a relative measure of days supply remaining in the context of the historical lowest DSR for that month. A SRI value of 1.0 means that the DSR is the highest possible DSR in the historical record for that month, while an SRI value of 0.5 means that the days supply remaining is halfway between the driest historical DSR value and the wettest DSR for EID's period of record, 1922-2004. The indicators and triggers that lead to Stage 1, Stage 2, or Stage 3 drought declarations are given below and summarized in Table 3. Stage 1, Stage 2, and Stage 3 drought lead to a total reduction in system demand of 15%, 25%, and 50%, respectively.

1. If it's May and SRI is less than 0.6 go to Stage 1; if already in drought, stay at the stage from the month before.
2. In June through September, if SRI is less than 0.10 and the previous month was in a Stage 2 drought, then go to Stage 3.
3. In June through September, if the SRI is less than 0.12 and the average previous three months ENSO is less than 0.35, then go to Stage 2; if the previous month was in Stage 3 drought, Stay in stage 3.
4. In all months if SRI is greater than 0.75, there is no drought curtailment. This either continues a period of no drought or ends the drought response of the month before.
5. In all other cases, the drought stage this month is the same as last month.

We have used a historical reconstruction of the ENSO index, choosing the 30-year period from 1954 through 1984 as a period of greater La-Nina activity, and have assumed that that the same ENSO sequence would occur from 2000 through 2030.

Table 3. Supply Remaining Index Plan

SRI Trigger Plan Summary Table				
Month	ENSO	SRI	Last month's stage	This month's stage
May	Any	<0.6	0	1
		<=0.75	1,2,3	Last month's stage
June - Sept	Any	<0.10	2	3
	<0.35*	<0.12	0,1,2	2
	<0.35*	<0.12	3	3
Any	Any	>0.75	0,1,2,3	0

* the ENSO average of three previous months must be less than 0.35

The SRI trigger plan that defines the drought stage is given according to month, ENSO, SRI, and last month's stage. We summarize how the SRI trigger plan is implemented in WEAP with reference to the month type (first column in table above). Note that time step (ts) 31 is the beginning of May, while ts=35 is the end of May. The WEAP `PrevTSValue()` function is used to look back at previous drought condition (e.g. "Last Month's Stage", column 5) to determine this weeks drought condition (e.g. "This month's Stage", column 6). Note, the expressions for SRI, Stage and ENSO are not shown, but are also part of WEAP's Drought Plan key assumptions. Figure 8 shows the WEAP interface and its implementation of the SRI Plan, and shows the ENSO index, the Drought Stage, and the Response.

May Rules

```
If (And (ts>=31, ts<=35, SRI<0.6, PrevTSValue(Stage, 1, 4, 3)=0), 1,
And (ts>=31, ts<=35, SRI<=0.75, PrevTSValue(Stage, 1, 4, 3)>0), PrevTSValue(Stage))
```

June-Sept Rules

```
And (ts>=36, ts<=52, SRI<0.10, PrevTSValue(Stage, 1, 4, 3)=2), 3,
And (ts>=36, ts<=52, PrevTSValue(ENSO, 1, 12, 1)<0.35, SRI<0.12,
PrevTSValue(Stage, 1, 4, 3)<3), 2,
And (ts>=36, ts<=52, PrevTSValue(ENSO, 1, 12, 1)<0.35, SRI<0.12,
PrevTSValue(Stage, 1, 4, 3)=3), 3,
```

Any Month Rule (if in any week, the SRI is greater than 0.75, then drought ends or is not declared). `If (SRI>0.75, 0, PrevTSValue(Stage))`

Figure 8. Screen shot of the implementation of the SRI Drought Plan in WEAP.

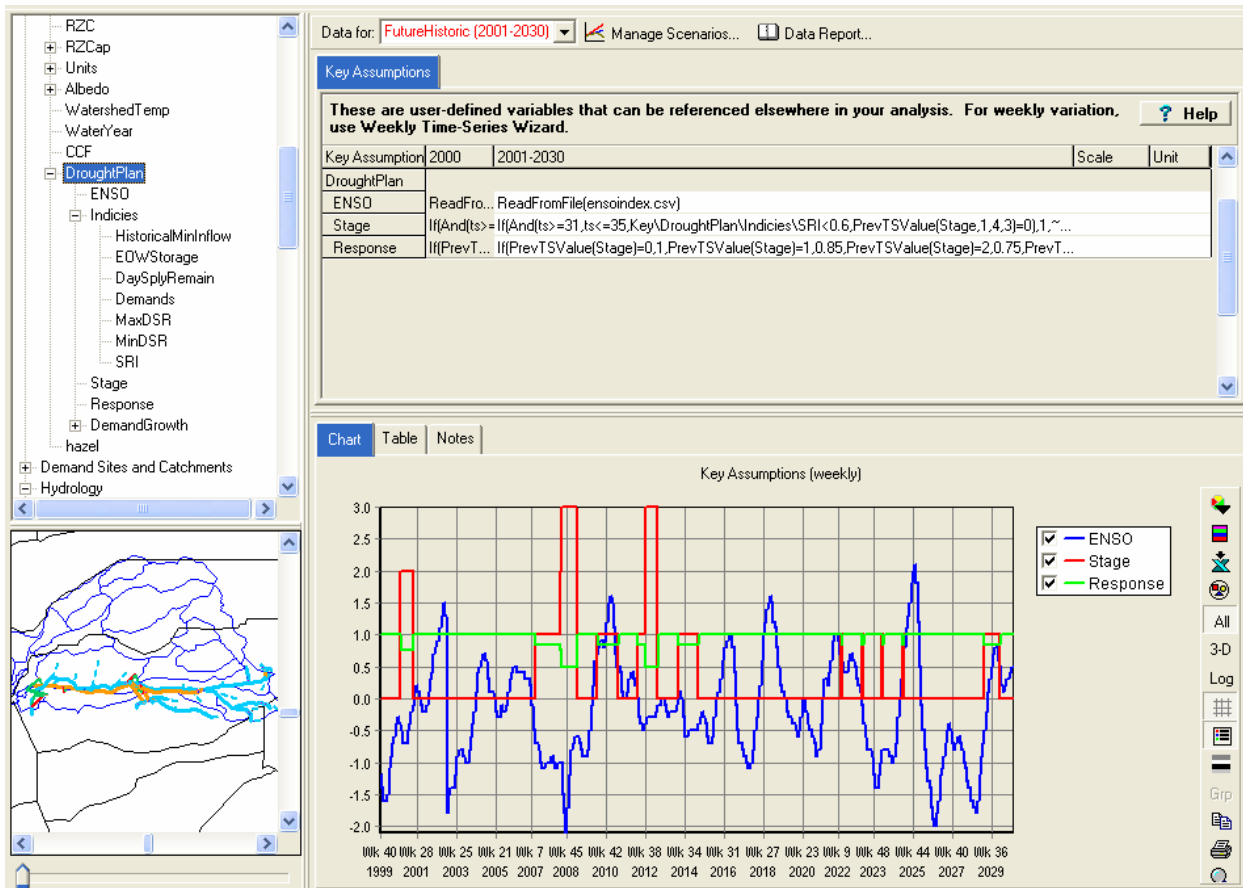
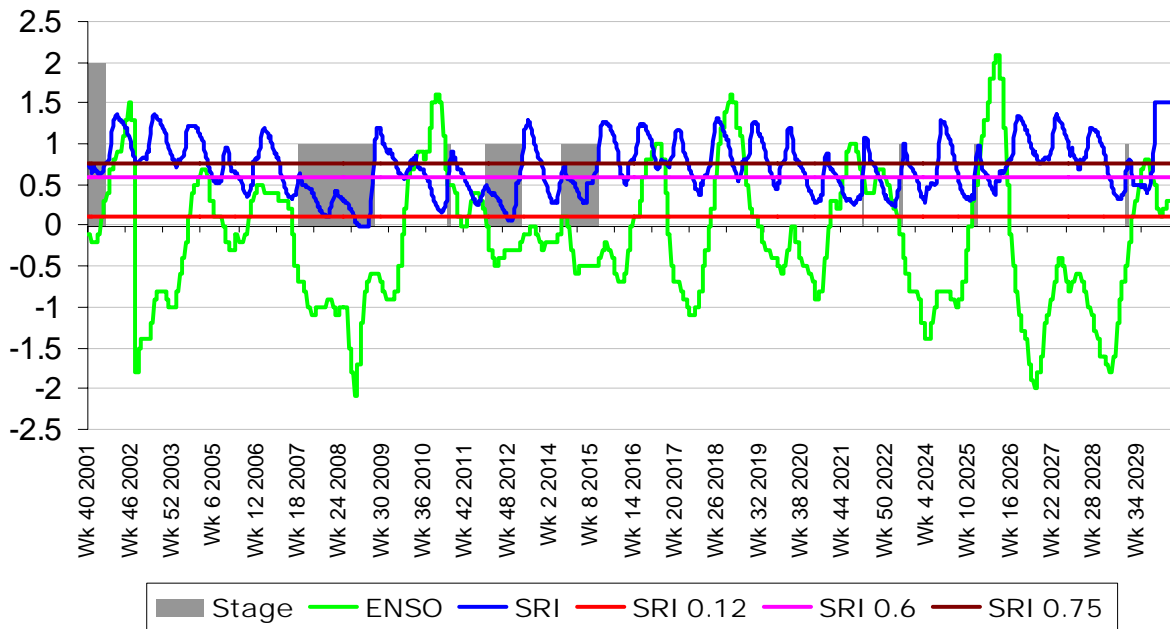


Figure 9 shows the ENSO index (green line), the Supply Remaining Index (blue line). The gray area in the figure is the Drought Stage for the 'Future Scenario using Historic Data, and include the three SRI trigger points of 0.75, 0.60 and 0.12 that are used to define drought initiation and stage (Table 3). Note that the SRI index tends to always stays about the 0.12 value after around 2012, under the assumption that the past hydrology repeats itself.

Figure 9. ENSO, SRI and Drought Stage for the 'Future Historic' Scenario



5 Future Scenarios for the EID Drought Plan Analysis

Global Climate Models or GCMs are developed and run by many research institutions around the world. While they are in general agreement about trends in temperature and precipitation, there is definitely variation within the projections. Since selecting the best climate model is impossible, using an ensemble of GCM results is more appropriate when investigating climate change impacts and adaptation strategies for water utilities. Therefore, a key activity of the current NCAR-AwwaRF collaboration has been the development of projections of future climate that represent the current range of uncertainty embodied in the results from many GCMs. The methodology is founded on the Bayesian Ensemble Method (BEM) (Giorgi and Mearns, 2002; Tebaldi et al. 2004, 2005) that makes use of an ensemble of GCM projections to derive “probabilities” of change in key climate variables at both inter and intra annual timescales. The approach combines predictions from multiple GCM output (21 different models or ensemble members), and generates a statistical representation of temperature and precipitation change, at regional scales, that includes natural variability. Two relative weighting criteria are used in the technique. The first is a bias criteria which rewards models that perform well in reproducing current climate and discounts models that show a large bias when compared against the historical record of 1960 to 1990. The second weighting criteria is model convergence which more strongly weights models that form consensus regarding the future climate and down-weights models that yield extreme projections. Thus, model bias and convergence criteria relative weights are implicitly assigned to the GCM ensemble members.

Regional Climate Projections from Multi-Model (RCPM) Ensembles is a web-based data portal (Figure 10) that can deliver regionally specific projections of temperature and precipitation change based on the Bayesian model of Tebaldi et al. (2004, 2005). For any given season and emissions scenario, the Bayesian model is used to derive a Probability Density Function (PDF) of temperature and precipitation change. The available emission scenarios come from the Special Report on Emission Scenarios (SRES) and include A2 (high), A1B (midrange), and B1 (low emissions). The data portal returns regional change in precipitation and temperature, where change is the difference between two 20-year averages, for example 1980-1999 (the typical "current climate" period) versus 2080-2099.

Figure 10. RCPM web-site showing the break-down by regions.

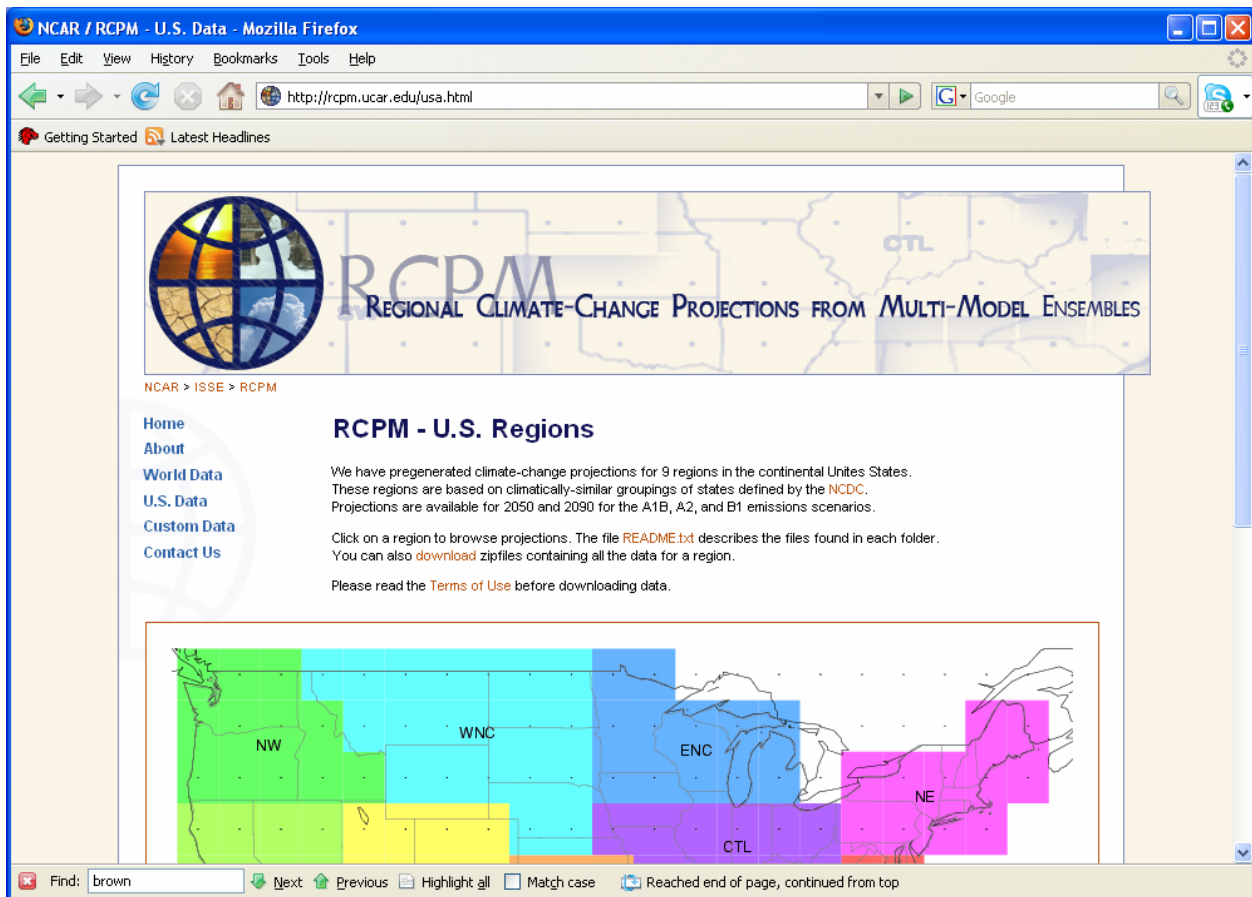
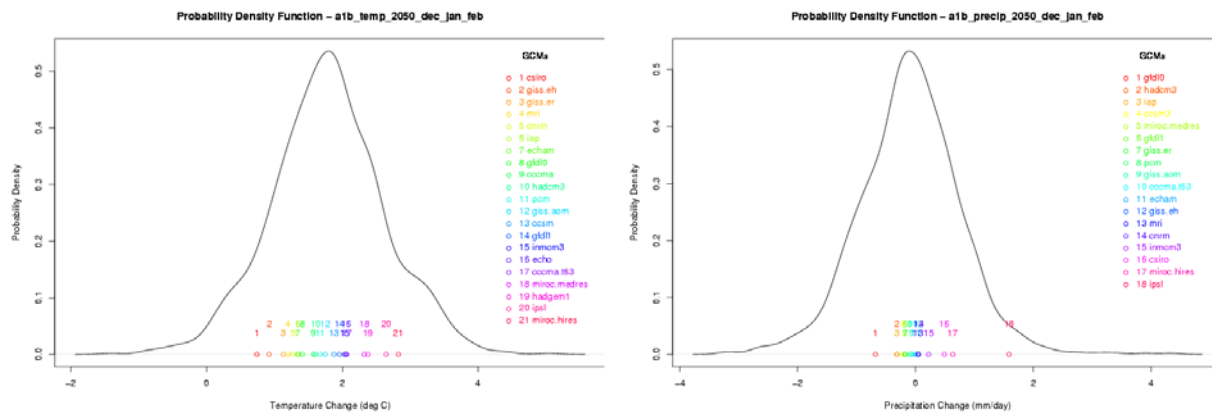


Figure 11 are frequency distributions of future climate change generated by the RCPM web-site for the Western United States. Results are for winter (Dec-Jan-Feb) around the 2050 decade, shown as continuous distributions, with the left graph, the absolute change in temperature (°C) and the right graph the change in precipitation depth (mm/day). These frequency distributions give a sense of the range of likely outcomes given an assumption about future emissions, and can be used to incorporate that uncertainty (as well as uncertainty about emissions) into thinking about future climate. They can be used as probable guidelines, but not certain forecasts: think in terms of bounding the set of likely scenarios, rather than picking a single characteristic outcome. The analysis is performed at a regional scale, using area-averaging from several gridpoints into means of temperature and precipitation.

These distributions of projected change can also be summarized by a set of discrete values along the continuous distribution, such as the 10%, 20%, ..., 90% deciles. The discrete decile values can be used by downscaling models to generate time series for use in the WEAP model (section 5.1)

Figure 11. Climate change frequency distributions for Northern California for the A1B emission scenario. The left graph is the projected absolute change in temperature, while the right graph is the change in daily precipitation around the decade of 2050 for December, January and February. These plots are generated through a statistical weighting of 21 different Global Climate Models (shown in right column of each graph). The relative contribution of each model is shown as colored values along the x-axis of each graph. Models with less weight will show to the extreme of the distribution.

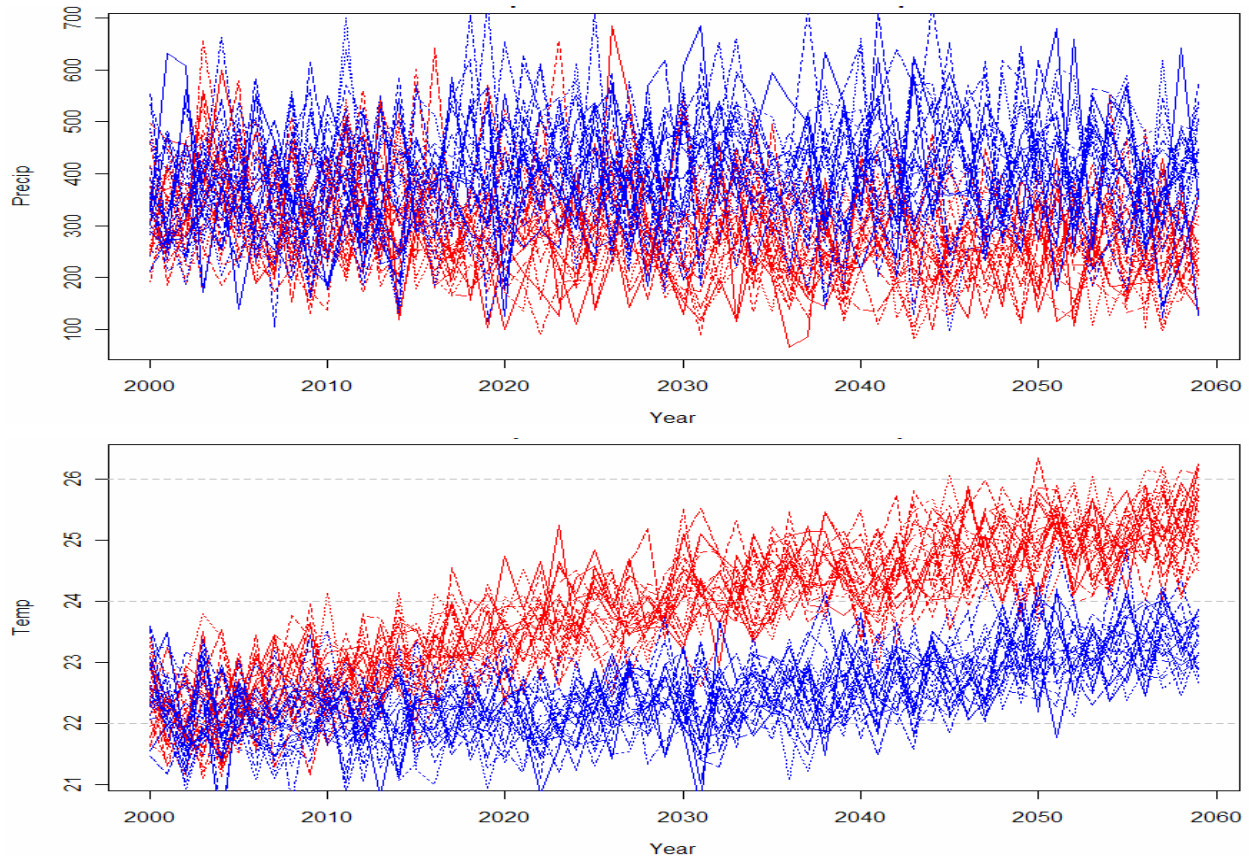


5.1 Creating Locally Relevant Climate Data from the BEM

Information derived from the BEM model is passed to a statistical downscaling method called K-Nearest Neighbor (KNN) that also yields frequencies of future climate but at daily timescales, and whose data can be used to drive local hydrologic model applications (Yates et al. 2003; Yates et al. 2005a,b). Downscaling is a generic term used to describe the translation of low resolution climate model output to higher resolution surface weather information. In short, the BEM is used to summarize results from an ensemble of climate models, since the results from individual models do not typically generate realistic weather at scales relevant for utility planners (local daily, weekly, or monthly time scales). Nonparametric methods like KNN provide a flexible framework, are parsimonious, make no assumptions of the underlying marginal or joint probability distribution of the variables, have the ability to reproduce any arbitrary functional relationship, and can be modified to do conditional simulation (e.g., conditioned upon the BEM output, ENSO, or other metrics). Information from the discrete BEM percentiles is passed to KNN, which uses these data to generate new weather data relevant for utility modeling applications that preserves the regional climate change signal derived from the BEM.

The KNN algorithm makes use of historical weather data that is strategically re-sampled in a manner such that changes in climate are reflected in new, synthetic daily weather sequences. The KNN algorithm can generate alternative weather sequences based upon prescribed conditioning criteria, such as the frequency distributions from the BEM. Notice that the resampling technique is particularly appropriate for near term projections, i.e., out to 10/20/30/50 years, when the changes in climate are still within or near the range of historically observed climate. Figure 12 shows 20 synthetic times series of annual precipitation for a 60 year period derived from daily data in the American River Basin using KNN and conditioned off the ensemble members for the 25th (red) and 75th (blue) Quartiles (Figure 11). Note that the 25th quartile scenarios can be considered a set of “dry and warm” scenarios, while the 75th quartile scenarios are a set that exhibits “little precipitation change, with more modest warming”. The red series corresponds to the 25th quartile (dry-very warm), while the blue series are the 75th quartile (slightly wet-warm).

Figure 12. These are twenty K-NN runs for both 25th and 75th quartile estimated from the statistical distribution of precipitation change shown in Figure 11. The blue lines are runs from 75th Quartile (wet portion of the distribution), while the red lines are runs from 25th Quartile (dry side of the distribution). The top graph is the total annual precipitation, while the bottom graph is the annual average temperature for a 60 year period in the future.



5.2 Ten Climate Change Scenarios for EID

The KNN algorithm was used to strategically resample from the historic data, yielding new time series for the 17 catchments of the EID system that have statistical attributes that differ from those of the historic record. We constrained ourselves to 10 individual scenarios, whereby the K-NN algorithm was used to generate new daily climate traces or runs that were aggregated into weekly averages (temperatures) and totals (precipitation). These data were then run through the WEAP model of the EID system. Three conditioning criteria or weighting factors, w_i were used to bias the resampling of the historic data. Each weighting factor is then combined to generate an overall weighting factor, $w=w_1*w_2*w_3$.

The frequency distributions from the 25th and 75th quartile BEM analysis were used to generate weighting factors based on precipitation change, yielding new climate sequences that were consistent with the trends suggested by the BEM analysis for the A1B climate scenario (Figures 11 and 12). This is the first weighting factor, w_1 . The second criteria preserves the inter-annual variability by conditioning off the 1983 through 2003 historical precipitation trend, w_2 ; and the third criteria was the random introduction of a 3 year drought sequence within the 30 year period, w_3 .

The onset of the 3-year drought sequence was established by selecting five uniform random numbers between 1 and 30 corresponding to years 2001 through 2030. Each of the five random numbers corresponded to the five scenarios for both the 25th and 75th quartiles of the BEM distribution (e.g. the first random number corresponded to scenarios 2 of the 25th and 75th quartiles). From the random number generation and mapping to a particular year, drought year onset was assumed to begin in year 6, 18, 8, 27, and 21 for scenarios 1 through 5 of both the 25th and 75th quartile scenarios, and last for 3 years. Figure 13 shows the weighting maps used to condition the K-NN algorithm to generate new climate sequences for the WEAP model. Values greater than 1.0 favor wetter resamples, while values less than 1.0 favor drier resamples. The arrows show where a three year drought sequence began for two of the scenarios. The x-axis are weeks in the year, while the y-axis are years. A total of 10 weighting maps were produced (only two are shown). The left map is for 25th Quartile, with severe drought onset around 2018, which is reflected in the red and yellow colors of the image. The right map is for the 75th Quartile, with drought onset in year 2021. This drought sequence is more difficult to discern, since it sits on top of an underlying wet period that is part of the underlying historic record.

In summary, five scenarios were generated from the 75th quartile (the blue series in Figure 14, which corresponds to little average annual precipitation change, and about a 1°C annual average warming by 2030), and another five scenarios were generated for the 25th quartile (the red series in Figure 15 corresponding to drier and warmer conditions, with an annual average precipitation decrease of about 15 percent and an increase in temperature by about 1.4°C). For reference purposes, the black lines in both figures are the 24 year observational record from 1980 through 2003, repeated for the period 2001 through 2024

Figure 13. KNN weighting maps, which are used to bias the selection of days in the K-NN resampling procedure. The left graph is the weighting used for 25th Quartile, runs, while the right graph is the weighting used for the 75th Quartile runs. The lines on the graph show the location of the random initiation of a 3-year drought sequence.

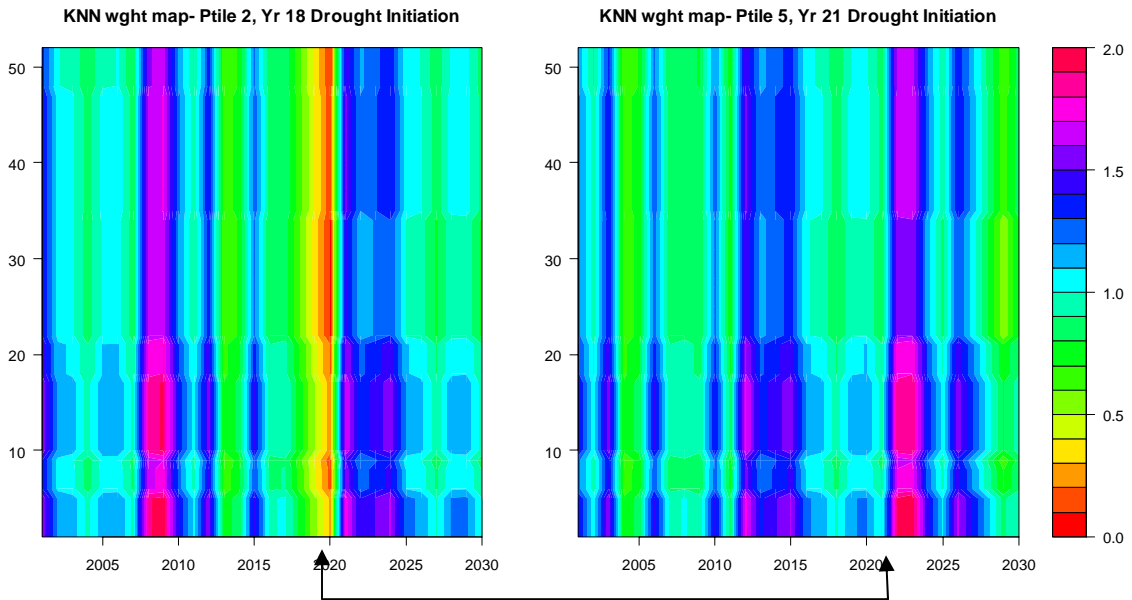
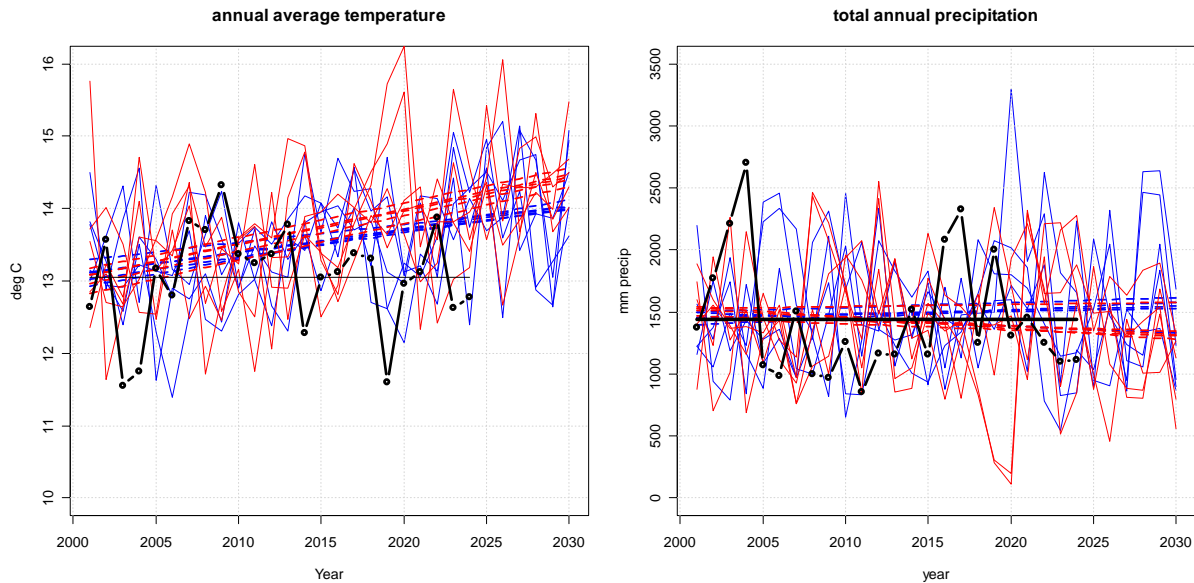


Figure 14. The K-NN algorithm was used to generate five unique climate traces for the 25th and 75th quartile of the distributions shown in Figure 11. Each of the traces is summarized as the regional average annual temperature (left) and total annual precipitation (right). The black lines are the historic regional average temperature and total annual precipitation (with trend lines), which should be used as a reference to gauge each unique climate trace. The red traces are for 25th Quartile, which tends to be drier and warmer relative to the blue traces, which are from the 75th Quartile and slightly wetter and not as warm (when compared with 25th Quartile).



6 Evaluating EID’s SRI Drought Plan in WEAP

The WEAP IWRPM framework was shown to adequately capture the overall water balance of El Dorado Irrigation District’s water supply system, at a fairly high level description, taking into account important regional and temporal characteristics. A key feature of the model is its ability to characterize the complete hydrologic cycle, which allows the planner to track mass balance changes in terms of both the magnitude and timing of water as it moves through the watershed.

The 10 climate change scenarios were run through the WEAP EID model to evaluate the response of the water system and the drought plan, with results summarized below. These 10 scenarios were compared with a simulation called ‘Future with Historic Data’, where we assumed that the climate series from 1980 through 2003, repeated itself from 2000 through 2030. In all the figures shown below, the blue series are for the five, 75th quartile, the red series are for the five 25th quartile scenarios, while the black line is the *Future with Historic Data* run, which assumes the 2001 through 2030 period consists of a 30 year series consisting of 1981 through 2003 (24 years) and 1981 through 1986 (6 years) “tacked on the end” to achieve a total of 30 years of simulation.

Figure 15 are the average streamflow near the Kybrz diversion (left) and total storage of EID reservoirs including Echo, Aloha, Caples, Silver, and Jenkinson (right). Recall that the 25th Quartile scenarios (red lines) are about 1.4°C warmer by 2030 and have a slight drying trend, while the 75th Quartile scenarios (blue lines) are about 1.0°C and have a slight wetting trend. The two most pronounced features of the streamflow simulations are the greater spring peak flows and the reduced mid and late summer low flows (week 40 corresponds to the first week in July). These generally higher winter time flows correspond with greater surface storage, a particularly interesting outcome of most of the 75th Quartile scenarios (Fig. 15, right). Surface storage for the 25th Quartile scenarios (slight drying trend, and warmer), also showed greater storage from mid-winter through spring, although some scenarios resulted in low spring and late summer storage.

Figure 15. Average weekly streamflow at Kybrz (left) and average total storage (right) based on the 10 scenarios over 30 year (e.g. 2001 through 2030). The red lines are from the 25th Quartile, while the blue lines are from the 75th Quartile.

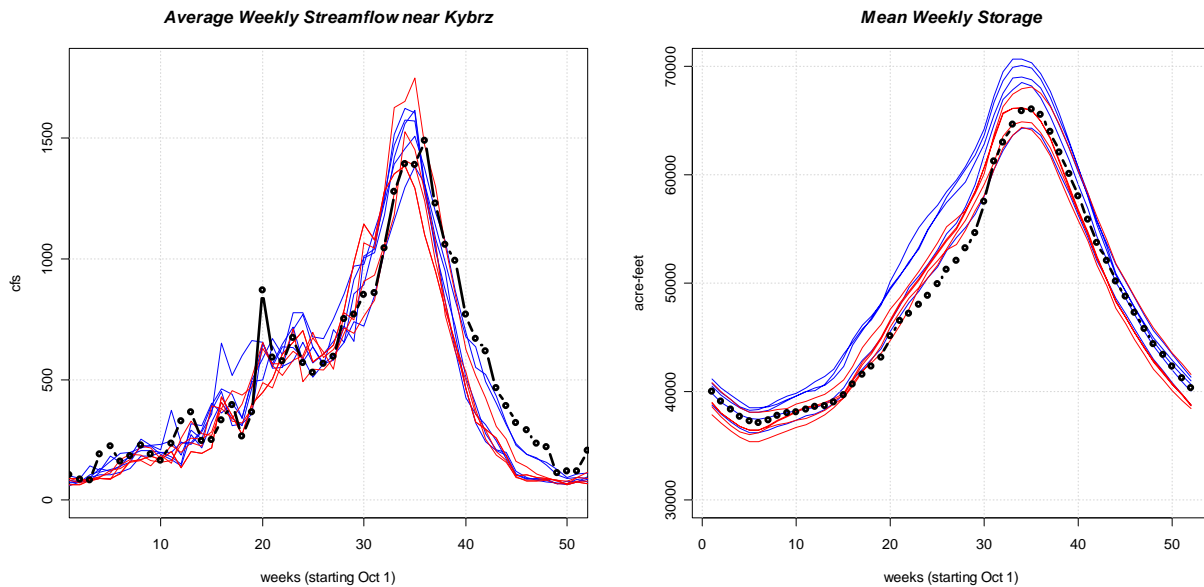


Figure 16 summaries the total annual hydropower generation (left) and the total unmet demand (right) for the 30 year simulation of all ten climate scenarios and the single “Future Historic” scenario. The plots include the long-term, linear trend. All scenarios tend to suggest declining hydropower generation and an increase in unmet demand. This unmet demand is in the context of the Drought Plan, so when drought is declared, demand is reduced based on the stage (Stage 1, Stage 2, and Stage 3 corresponds to an assumed 15%, 25% and 50% reduction in demand, respectively). Most of the unmet demand is at the High Sly/184 demand site, which can satisfy its demand by drawing water from either the EID canal or from the Sly Park/Jenkinson

Lake supply. Currently, the model is configured to only take Sly Park water if Jenkinson Lake is below 32,000 acre-feet, else the High Sly/184 demand is met by drawing water from the EID canal (Project 184). While the unmet demand does increase under the various scenarios, unmet demand is only about 10% of total demand under non-drought conditions.

Figure 16. Total annual hydropower generation (left) and total demand-supply shortfall or unmet demand (right) for the 25th (red) and 75th (blue) Quartiles.

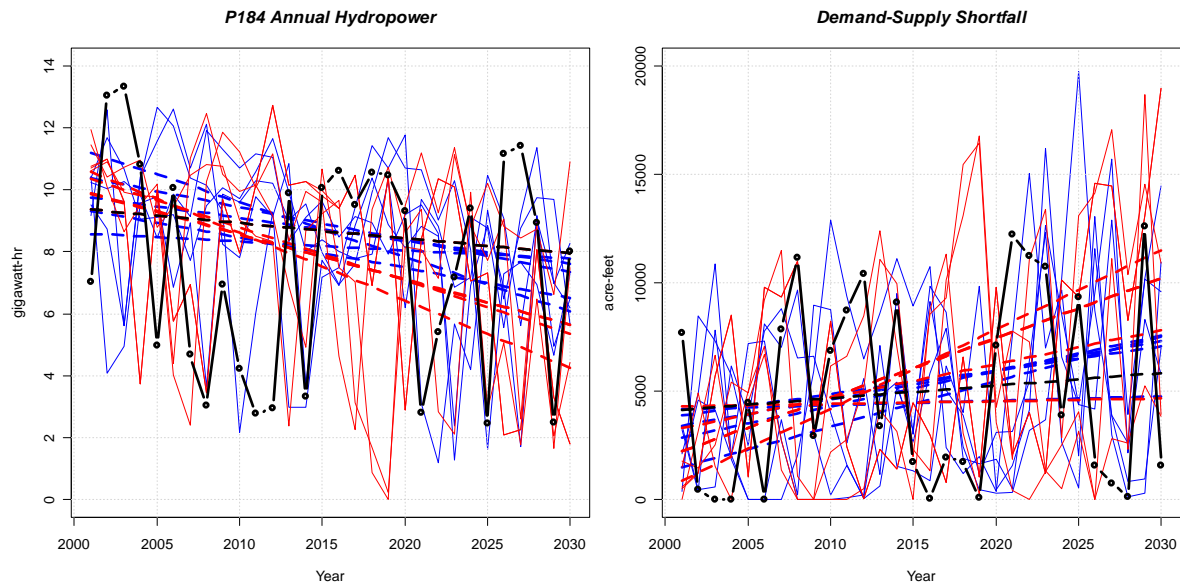


Figure 17 shows the percent time that drought is declared (Stage 1, 2 or 3) for the 30 year period for both the *Future with Historic Data* scenario (black), the five scenarios of the 25th Quartile (red) and the five scenarios of the 75th Quartile (blue). It is interesting to note that the two future “climate change” scenarios (25th and 75th Quartiles) actually produce fewer drought declarations (Stage 0) when compared with the *Future with Historic Data* scenario. Also, note that there very few declarations of Stage 2 drought. This is primarily due to the fact that the Stage 2 condition can only be initiated in June through September, when the ENSO index is less than 0.35 and the SRI index is less than 0.12 (see Table 3). Stage 3 drought is triggered when the SRI drops to 0.10, ENSO is less than 0.35 and Stage 2 drought exists. Since Stage 3 initiation is similar to Stage 2, the modeled dynamic is a brief period of Stage 2 drought then soon followed by Stage 3 drought, as the SRI index can quickly transition from a value of 0.12 and 0.10 over a short time period. Stage 2 tends to trigger in the spring when SRI is below 0.12 corresponding to drier conditions. For the ten scenarios used here, the SRI quickly drops below 0.10, triggering a Stage 3 drought.

Figure 17. Percent time of each Drought Stage for the 2001 through 2030 period.

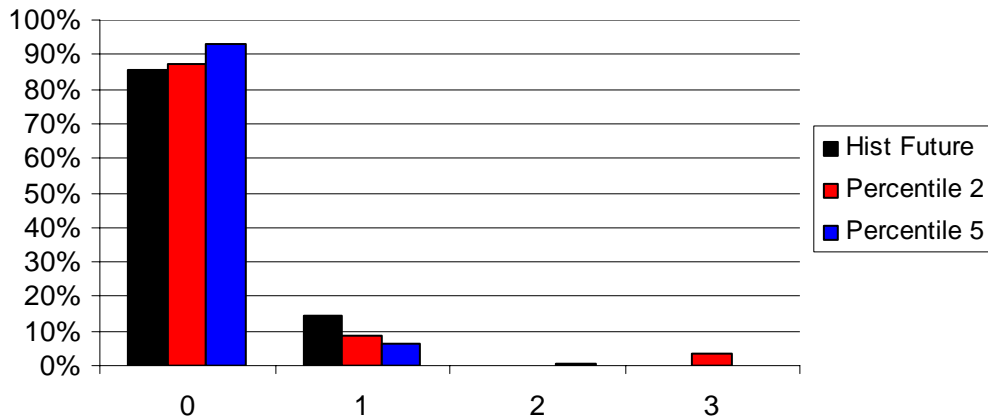
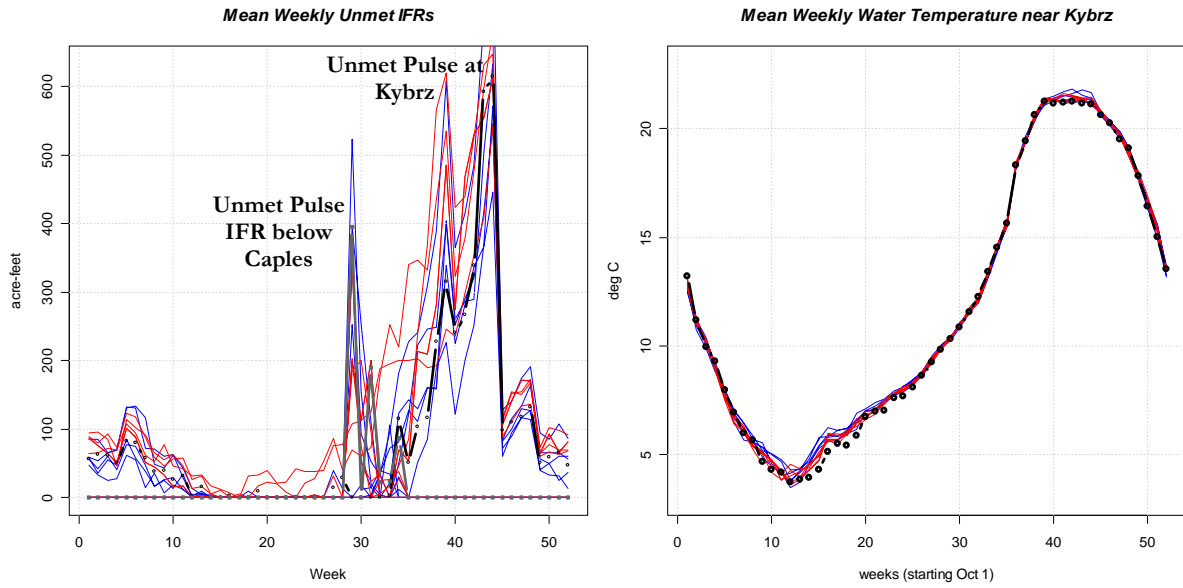


Figure 18 shows the average weekly unmet demand for two instream flow requirements (left). Note that all scenarios suggest an increase in the unmet IFR, although more substantial on the South Fork, with about a 10% decrease in flow requirement coverage for the 25th and 75th quartile scenarios (not shown). Figure 17 includes the average weekly water temperature near Kybrz, and it is interesting to note that there is little change in simulated water temperature. More work is needed here in estimating tributary temperature changes under the different scenarios, since these were not explicitly modeled. The result does suggest that since the priority on the river is to maintain instream flow requirements and these requirements are being largely met through releases from reservoirs in late summer, river temperatures might be modestly impacted by moderate warming suggested by the 25th and 75th quartile scenarios.

Figure 18. Unmet average annual IFRs (left) and water temperature near Kybrz.



References

- Arnold, J. and Allen, P. 1993, A comprehensive surface-groundwater flow model, *J. of Hydrology*, 142, 47-69.
- Asner, G., J. Scurlock and J. Hicke, 2002, Global synthesis of leaf area index observations: implications for ecological and remote sensing studies, *Global Ecology & Biogeography*, 12 3 pg. 191.
- Doherty, J. 2002, Model Independent Parameter Estimation, (PEST), User's Manual, 5th Addition, Watermark Numerical Computing, 7944 Wisconsin Ave, Bethesda MD. 20814
- Draper, A.J., M.W. Jenkins, K.W. Kirby, J.R. Lund, and R.E. Howitt "Economic-Engineering Optimization for California Water Management," *Journal of Water Resources Planning and Management*, Vol. 129, No. 3, May/June 2003.
- DWR (1998), *The California Water Plan Update: Bulletin 160-98*, Volume 1 and 2, California Department of Water Resources,
- DWR (2005), Division of Planning and Local Assistance, Department of Water Resources, 901 P Street, "Crop Water Use". Sacramento, CA 95814-3515
- DWR (2003) California's Groundwater- Bulletin 118, Update 2003. 1416 9th Street, Sacramento, CA 95814.
- Fontaine, T.A., T. Cruikshank, J. Arnold and R. Hotchkiss, 2002, Development of a snowfall-snowmelt routine for mountainous terrain for the soil water assessment tool (SWAT), *J. of Hydrology*, 262, (1-4):209-223.
- Giorgi, F., and L. Mearns, 2002: Calculation of average, uncertainty range and reliability of regional climate changes from AOGCM simulations via the 'reliability ensemble averaging' (REA) method, *J. Clim.*, 15, 1141-1158.
- Kergoat, L. 1998: A model for hydrological equilibrium of leaf area index on a global scale. *J. of Hydrology*, 212, 268-286.
- Raskin, P., E. Hansen and Z. Zhu, 1992, Simulation of water supply and demand in the Aral Sea Region, *Water International*, Vol. 17, No. 2.
- Ritschard, R., J. Cruise and L. Hatch, 1999, Spatial and temporal analysis of agricultural water requirements in the Gulf Coast of the United States, *J. of American Water Resources Association*, 35, 6, 1585-1596. *Simulation*, 64 (2004), pp.13-24

Srinivasan, R., J. Arnold and C. Jones, 1998, Hydrologic modeling of the United States with the soil water assessment tool., *Water Resources Development*, 14,3, 315-325.

Tebaldi, C., L. Mearns, D. Nychka, and R. Smith, 2004: Regional probabilities of precipitation change: A Bayesian analysis of multimodel simulations, *Geophys. Res. Lett.*, 31 (L24213), doi:10.1029/2004GL021276.

Tebaldi, C., R. Smith, D. Nychka, and L. Mearns, 2005: Quantifying uncertainty in projections of regional climate change: A Bayesian approach to the analysis of multi-model ensembles, *J. Clim.*, 18 (10), 1524–1540.

Thornton, P.E., S.W. Running, and M.A. White. 1997. Generating surfaces of daily meteorology variables over large regions of complex terrain. *Journal of Hydrology* 190:214-251.

Yates, D., Gangopadhyay, S., Rajagopalan, B., and K. Strzepek, 2003, A technique for generating regional climate scenarios using a nearest neighbor algorithm, *Water Resources Research*, 39, 7, 1199, doi:10.1029/2002WR001769.

Yates, D., J. Sieber, D. Purkey, and A. Huber-Lee, 2005a., WEAP21 a demand, priority, and preference driven water planning model: Part 1, Model Characteristics, *Water International*, 30,4, pg 487-500.

Yates, D., D. Purkey, H. Galbraith, A. Huber-Lee, and J. Sieber, 2005b, WEAP21 a demand, priority, and preference driven water planning model: Part 2, Aiding freshwater ecosystem service evaluation, *Water International*, 30,4, pp. 501-512.

Zagona, E., T. Fulp, R. Shane, T. Magee, and H. Goranflo (2001), RiverWare: A Generalized Tool for Complex Reservoir Systems Modeling, *Journal of the American Water Resources Association*, 37(4):913-929.77

APPENDIX C

Board Policy 5000 Water Supply

BP 5000 WATER SUPPLY

BP 5010 WATER SUPPLY MANAGEMENT

Adopted: August 28, 2006
Supersedes: Regulation No. 1 – adopted March 24, 1982, amended April 21, 2003
Regulation No. 2 – adopted July 24, 1989, amended August 6, 2001
Regulation No. 3 – adopted October 25, 1993
Regulation No. 7 – adopted December 14, 1988, amended October 21, 2002
Regulation No. 10 – adopted September 30, 1981, amended February 7, 2000
Regulation No. 11 – adopted June 17, 1984

The Board is committed to provide a water supply based on the principles of reliability, high quality, and affordability in a cost-effective manner with accountability to the public. It is the General Manager’s responsibility to ensure that the tenets of this policy are carried out in an open, transparent manner through sound planning, to assure preparedness under varying conditions, and effective management.

It is the policy of the Board that the District will not issue any new water meters if the *Water Resources and Service Reliability Report* indicates that there is insufficient water supply. When warranted by the findings of the report, the General Manager will bring the possibility of restrictions on meter issuance to the Board’s attention. Any such restrictions will be established pursuant to Water Code Section 350 et. Seq. of the California Water Code.

AR 5010 Water Availability and Commitments

AR 5010.1 Annual Reporting

The District will maintain adequate water supply and demand records to ensure accurate monitoring and reporting. The General Manager will ensure that an updated *Water Resources and Service Reliability Report* is prepared annually for review by the Board of Directors. The report will include the current system firm yield of the overall District, along with the water supply and infrastructure capacity, potential demands, existing commitments, and meter availability for each water service area of the District as defined in the report.

AR 5010.2 Shortages

The *Water Resources and Service Reliability Report* will use a system firm yield method to determine that sufficient water supply exists to meet potential demands. Under this methodology, approximately 95% of the time sufficient water supply is available to meet normal water demands, but during the remaining 5% of the time water shortages may occur. Such shortages may result in the implementation of voluntary or mandatory conservation measures.

AR 5010.3 New Meter Restrictions

Should findings in the *Water Resources and Service Reliability Report* warrant restrictions on the issuance of new water meters, the General Manager will bring the situation to the attention of the Board of Directors. During emergency conditions when supplies are restricted or limited, the General Manager may also bring to the Board's attention possible restrictions on water meter availability.

AR 5011 Water Supply Management Conditions

The District recognizes that variations in weather patterns can cause watersheds to yield different quantities of water supply in any given year. In some years, dry weather or drought conditions may occur which result in varying degrees of water shortage. The following water supply management conditions describe the incremental steps needed to manage increasing levels of shortage. Specific procedures for implementing these conditions are currently outlined in the District's *4-Stage Water Supply Matrix and Water Shortage Response Measures*, adopted by the Board of Directors on June 12, 1995.

AR 5011.1 Condition 1 – Normal or Unrestricted Water Supply

Condition 1 is considered to be in effect at all times unless another condition is declared. Condition 1 will be in effect during periods when normal water supplies and normal distribution capacity are available and the District anticipates the ability to meet the unrestricted demands of its customers.

AR 5011.2 Condition 2 – Slightly Restricted Water Supplies

The objective of Condition 2 is to heighten public awareness of emerging water shortage conditions and enlist voluntary customer participation in reductions of water use.

AR 5011.3 Condition 3 - Moderately Restricted Water Supplies

The objective of Condition 3 is to ensure public understanding of worsening water supply conditions and evoke customer compliance with voluntary and mandatory conservation measures.

AR 5011.4 Conditions 4 - Severely Restricted Water Supplies

The objective of Condition 4 is to confirm public recognition of the continuing water supply emergency and impose mandatory conservation measures in addition to those in effect during Condition 3.

AR 5011.5 Condition 5 - Declared Water Shortage Emergency

The objective of Condition 5 is to ensure that the use of District water is limited to those needs associated with maintaining public health, safety, and welfare when either of the following circumstances exists:

- a) A water shortage condition exists because of drought.
- b) The General Manager has declared a WATER SHORTAGE EMERGENCY due to an existing condition or when there is a high probability that a condition will be realized in the near future. Such conditions may include an unexpected disruption of supply, storage, or distribution system facilities.

AR 5012 District Infrastructure and Facilities

AR 5012.1 Connections to District Infrastructure

Connections to the District's infrastructure shall be made only by District employees or under the direct supervision of District employees. No connection to District infrastructure shall be made without prior approval.

AR 5012.2 Responsibility for Infrastructure Maintenance

The District's ownership of and responsibility for the operation and maintenance of facilities will end at the discharge side of the meter, discharge conduit, or check valve assembly. The District will be responsible to operate, maintain, and replace District water mains, flumes, ditches, and other facilities of the District's total supply, transmission, and distribution system. The District's water supply system shall be under the exclusive control and management of duly appointed District personnel, and no one shall have any right to operate, maintain or replace any of the District's water facilities, or interfere with the District system in any manner.

For service through private waterlines or community group systems, measuring devices placed within these systems shall be at the sole discretion of the District. Any such placement, however, does not create an obligation on the part of the District for the operation, maintenance, or replacement of the private waterlines or group system.

AR 5013 Water Service Interruptions or Restrictions

Water service interruptions or restrictions may occur during water supply conditions 3, 4, or 5 when the District may, with prior notification, temporarily remove or lock off meters or otherwise interrupt water service to classifications not assigned for human consumption.

Irrigation and agricultural services provided by the District may be subject to an interruption or restriction under these conditions. Construction fire hydrant meters or other temporary water meter services provided by the District may also be subject to removal, lock-off, restriction, or discontinuance.

The District may also restrict water availability to construction fire hydrant meters in certain locations due to constraints in the distribution system.

AR 5013.1 Violations

The District reserves the right to interrupt or restrict, without prior notice, any irrigation or agricultural service, construction, or temporary meter that is found to violate the restrictions imposed by a water shortage condition.

AR 5013.2 Service Interruptions due to Planned or Unplanned Maintenance

The District reserves the right at any and all times to shut off water delivery or reduce pressure for the purpose of maintenance or making repairs and alterations to the water system. Whenever possible, advance notice of interruption of service will be given to all affected water users.

AR 5014 Fire Suppression

A fire suppression system may consist of a private interior fire sprinkler system or public fire hydrants. The fire protection agency having jurisdiction over the property will set the fire suppression requirements. The District will provide water for fire hydrants and other fire suppression facilities, but does not warrant or guarantee any range of pressures or rates of flow. The District will not be liable for water pressure or damage in any manner that arises from the availability of water or water pressure at any hydrant or facility used for fire suppression.

The District will provide water at no cost to fire protection agencies for the purpose of fire suppression activities. These activities include equipment maintenance, testing, training, fire hydrant flow testing, and the filling of fire suppression equipment. All other uses of water, including domestic and irrigation uses at fire stations, will be supplied in accordance with District regulations and procedures and must be metered and paid for by the fire protection agency.

AR 5014.1 Fire Hydrants

Public fire hydrants will be installed and connected to District mains when requested by the fire protection agency having jurisdiction or when required as a condition of a building permit or subdivision of land. The cost of the fire hydrant assembly and all other appurtenances, including installation, will be paid for by the holder of the building permit or the developer of the project. The District will review, approve, and inspect all public fire hydrant installations.

All public fire hydrants will be owned, operated, and maintained by the District from the water main up to and including the hydrant. All fire

hydrants will be inspected, tested, and externally maintained by the fire protection agency.

No person, other than authorized EID, fire district, or fire department personnel, shall open or draw water from any fire hydrant connected to the District's distribution system without prior specific authorization from the District. Refer to AR 9026.3 for authorized fire hydrant meter use.

The removal or relocation of any public fire hydrant must be approved by the District in advance, and any removal or relocation will be made at the expense of the person or entity requesting the change.

AR 5014.2 Commercial Fire Suppression Services

The property owner will be responsible for the expense of installing a commercial fire suppression system and appropriate backflow prevention device as required by the District. The District will review, approve, and inspect the private fire service installation up to the post-indicator valve.

Water provided to a fire suppression sprinkler system will not be used for any purpose other than extinguishing a fire or testing of the fire protection system.

AR 5014.3 Residential Fire Suppression Services

A residential fire sprinkler system may be served by the residential water meter except if a separate service line and water meter is needed to provide the required fire flow.

AR 5015 Ground Water Supply

Because of the unreliable nature of underground water sources in most of El Dorado County, ground water will not be relied on to augment firm yield supply or as a sole source of water for domestic, irrigation, or fire-fighting purposes. Any consideration of direct ground water augmentation to the existing water system will be evaluated on the basis of short- and long-term reliability, quality, and economics. More than one professional, expert opinion regarding adequacy will be required. The costs of necessary tests, expert opinions, and District staff time will be borne by the applicant.

BP 5020 CROSS-CONNECTION CONTROL AND BACKFLOW PREVENTION

Adopted: August 28, 2006
Supersedes: Regulation No. 10 – Prevention of Contamination by Backflow and Cross Connections, Adopted September 30, 1981, Amended February 7, 2000

The District will establish and maintain a cross-connection control program according to the California Code of Regulations - Title 17, Section 7583-7605, or their successors.

BP 5030 WATER CONSERVATION

Adopted: August 28, 2006
Supersedes: Regulation No. 21 – Conservation, Adopted June 10, 1981

It is Board policy to take reasonable and prudent measures to conserve all water and to adopt and implement water-use efficiency programs that will benefit its customers.

BP 5040 DROUGHT PREPAREDNESS AND CLIMATE VARIABILITY

Adopted: August 28, 2006
Supersedes: Regulation No. 2 – Water Supply Reliability, Adopted July 24, 1989, Amended August 6, 2001

The Board supports the adoption and implementation of a drought preparedness plan to ensure a proactive response to the impacts of drought conditions. Included in the planning effort is consideration of climate variability.

BP 5050 WATERSHED MANAGEMENT

Adopted: August 28, 2006
Supersedes:

It is Board policy to adopt and support watershed management strategies that will maximize water supply reliability and water quality.

APPENDIX D

4-Stage Water Supply Matrix and Water Shortage Response Measures



El Dorado Irrigation District

EL DORADO IRRIGATION DISTRICT

4-STAGE WATER SUPPLY MATRIX

AND

WATER SHORTAGE RESPONSE MEASURES

Adopted by EID Board of Directors

June 12, 1995

INTRODUCTION

The El Dorado Irrigation District maintains a water conservation plan called the **4-Stage Water Supply Matrix and Water Shortage Response Measures**. This conservation program establishes a logical series (i.e. stages) of measures which respond to increasingly severe water shortage conditions. This is accomplished by articulating an objective for each stage, and listing the corresponding conservation measures which, when implemented, are expected to achieve the stated objective. The four stages and associated objectives are documented below.

STAGE ONE WATER ALERT (0% - 5% Expected Conservation)

Objective: Heighten public awareness of emerging water shortage conditions and enlist voluntary customer participation in increased water conservation.

STAGE TWO WATER WARNING (5% - 10% Expected Conservation)

Objective: Ensure public understanding of worsening water supply condition and evoke customer compliance with voluntary and mandatory conservation measures.

STAGE THREE WATER EMERGENCY (10% - 20% Expected Conservation)

Objective: Confirm public recognition of the continuing water supply emergency and impose mandatory conservation measures.

STAGE FOUR CRITICAL WATER EMERGENCY (20% - 30% Expected Conservation)

Objective: Ensure that District water use is limited to those needs associated with maintaining public health and welfare.

PROGRAM ADMINISTRATION

The District's 4-stage water conservation program is administered according to a "Water Matrix" (see Table 1). The monthly Sly Park storage volumes listed in the matrix represent the threshold, or "trigger" values, that must first be observed before declaring the applicable conservation stage and associated water use restrictions. Accordingly, progression into and out of the various water conservation stages, except Stage 1, is based on the amount of water stored in Sly Park Reservoir.

Because of certain unique circumstances, the declaration of Stage 1 conservation measures is handled differently than declarations of Stages 2, 3 and 4. Prior to declaring a Stage 1 Water Alert, the Sly Park storage levels are monitored daily until the level is 1,000 below the applicable first-of-the-month Stage 1 threshold. Declaring a Stage 1 Alert at this point prevents Stage 1 declarations from being made when the threshold storage levels are exceeded for short periods of time. As a result, District customers are not called on to observe Water Alert conditions off and on from month to month.

The chart below depicts the conditions under which Stage 1 declarations are made.

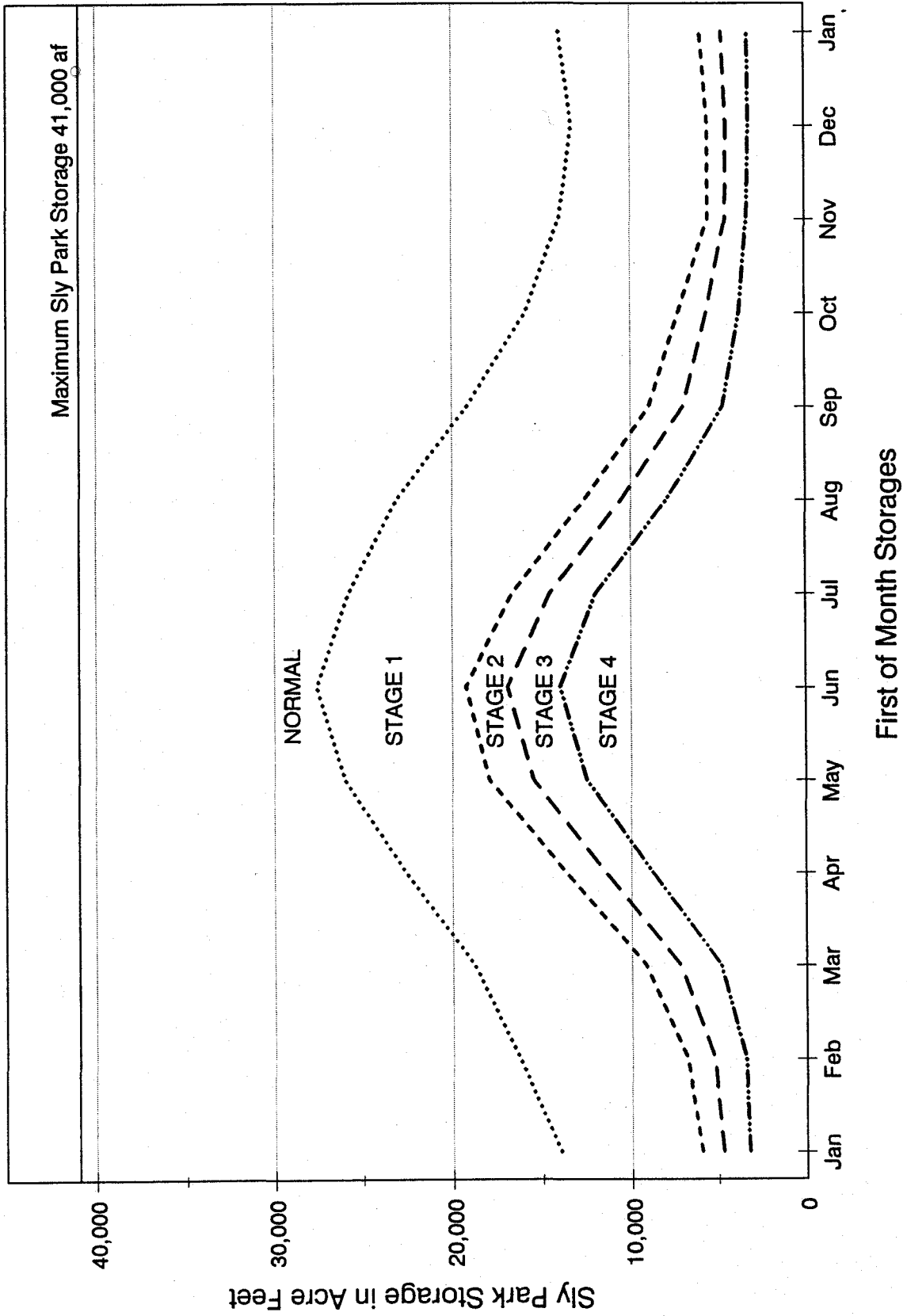
<u>MONTH</u>	<u>STAGE 1 THRESHOLD</u>	<u>STAGE 1 RESTRICTIONS IMPOSED</u>
January	14,000	13,000
February	16,300	15,300
March	18,800	17,800
April	22,600	21,600
May	26,000	25,000
June	27,600	26,600
July	25,800	24,800
August	23,100	22,100
September	19,200	18,200
October	15,900	14,900
November	14,000	13,000
December	13,300	12,300

TABLE 1
WATER MATRIX

(SLY PARK STORAGE VOLUME IN ACRE FEET)

1st of MONTH	NORMAL	STAGE 1	STAGE 2	STAGE 3	STAGE 4
OCTOBER	15,900 to 41,000	7,270 to 15,900	5,650 to 7,270	3,750 to 5,650	Below 3,750
NOVEMBER	14,000 to 41,000	5,560 to 14,000	4,530 to 5,560	3,300 to 4,530	Below 3,300
DECEMBER	13,300 to 41,000	5,560 to 13,300	4,490 to 5,560	3,200 to 4,490	Below 3,200
JANUARY	14,000 to 41,000	5,980 to 14,000	4,730 to 5,980	3,250 to 4,730	Below 3,250
FEBRUARY	16,300 to 41,000	6,840 to 16,300	5,260 to 6,840	3,450 to 5,260	Below 3,450
MARCH	18,800 to 41,000	9,190 to 18,800	7,210 to 9,190	4,850 to 7,210	Below 4,850
APRIL	22,600 to 41,000	13,680 to 22,600	11,450 to 13,680	8,800 to 11,450	Below 8,800
MAY	26,000 to 41,000	17,960 to 26,000	15,500 to 17,960	12,500 to 15,500	Below 12,500
JUNE	27,600 to 41,000	19,240 to 27,600	16,920 to 19,240	14,000 to 16,920	Below 14,000
JULY	25,800 to 41,000	16,670 to 25,800	14,580 to 16,670	12,000 to 14,580	Below 12,000
AUGUST	23,100 to 41,000	12,630 to 23,100	10,580 to 12,630	8,000 to 10,580	Below 8,000
SEPTEMBER	19,200 to 41,000	8,980 to 19,200	7,020 to 8,980	4,700 to 7,020	Below 4,700

EXHIBIT A
EL DORADO IRRIGATION DISTRICT
 Water Conservation Levels - Sly Park Storage



4-STAGE WATER SUPPLY MATRIX AND WATER SHORTAGE RESPONSE MEASURES

Stage One - "WATER ALERT" (0% - 5% Expected Conservation)

Objective: Heighten public awareness of emerging water shortage conditions and enlist voluntary customer participation in increased water conservation.

1. Initiate aggressive EID public information campaign to include informational publication/s mailed to all customers and ads in local newspapers describing situation and seeking support from customers to manage water supplies wisely and to be aware of current water situation.
2. Engage local radio and cable TV media outlets to advertise or announce water shortage information and promote customer wise water use.
3. Provide commercial agricultural customers with special water conservation information materials (literature) from the District.
4. Request all portable construction meter customers to voluntarily seek water sources other than potable EID water for dust control, earthwork, road construction, etc.

Stage Two - "WATER WARNING" (5% - 10% Expected Conservation)

Objective: Ensure public understanding of worsening water supply condition and evoke customer compliance with voluntary and mandatory conservation measures.

1. Intensify Stage 1 public information campaign.
2. Continue all other Stage 1 measures.
3. Implement **mandatory** conservation measures:
 - * Prohibit washing of driveways, parking lots and other surfaces with potable EID water.
 - * Ponds, lakes and other non-irrigation water features shall not be filled with potable EID water.
 - * Restaurants asked not to serve water to customers unless requested.
 - * Portable construction water meter customers directed not to use EID water for dust control, earthwork, or road construction.
4. Implement **voluntary** conservation measures:
 - * All outside watering, including garden, lawn, landscape, domestic and pasture irrigation, parks, golf courses, school grounds and public grounds shall occur only between 6:00 p.m. to 9:00 a.m.
 - * Empty swimming pools are not to be filled with potable EID water.
 - * No washing of automobiles, recreational vehicles, trailers, etc. with EID potable water.
5. Agricultural users not complying with existing Irrigation Management Service (IMS) Program to submit individual water conservation plans to EID for approval within 30 days of Stage 2 declaration.
6. Domestic irrigation users shall be sent an informational mailer which will include a "questionnaire" asking specific questions regarding the water shortage and how the customer intends to respond to it. All domestic irrigation customers will be required to return the questionnaire.

Stage Three - "WATER EMERGENCY" (10% - 20% Expected Conservation)

Objective: Confirm public recognition of the continuing water supply emergency and impose mandatory conservation measures.

1. Continue with Stage 2 informational campaign.
2. Continue Stage 2 mandatory measures.
3. Make Stage 2 voluntary measures mandatory.
4. Initiate steps and conduct public hearing(s) to consider Water Emergency pursuant to Water Code Section 350 et seq., and develop Rules and Regulations and associated enforcement powers appropriate to prevailing circumstances such as: drought water rates, citation and disconnect procedures, suspension of water meter sales, water patrol, etc.

Stage Four - "CRITICAL WATER EMERGENCY" (20% - 30% Expected Conservation)

Objective: Ensure that District water use is limited to those needs associated with maintaining public health and welfare.

1. Continue all Stage 3 measures.
2. Defer all proposed/new agricultural plantings until the water supply condition returns to a Stage 2 level and provided that it does not conflict with any established water emergency.
3. All outside watering including garden, lawn, landscape, domestic and pasture irrigation, parks, golf courses, school grounds and public grounds shall **not** be watered with potable EID water.

Adopted April 13, 1988 (5 Stage)
Revised April 10, 1989
Revised April 23, 1990 (4 Stage)
Revised May 30, 1990 (Resolution 90-91)
Revised February 25, 1991
Revised June 13, 1994
Revised June 12, 1995

4stage.95

APPENDIX E

Draft Ditch Operations Summary Guidelines

DRAFT Drought Ditch Operation Guidelines

GENERAL GUIDELINES:

Below is the current proposal for water supply conditions and corresponding drought stages. The proposed drought ditch operations are based upon this outline. It was decided that ditch customers should be subject to the same restrictions as domestic customers, in addition to outages due to a lack of supply - pursuant to Ditch Regulation No. 7. Potable water supplementation will not be available during a Drought Stage 3.

Drought Stage Response Summary			
Water supply conditions	Drought stage	Objective	Response actions
Normal 0% Total Supply Reduction	None - Ongoing conservation measures; water waste ordinance in effect.	Public awareness	Normal actions
Slightly Restricted Water Supplies (below normal) Up to 15% Total Supply Reduction	Drought Stage 1 – Introductory Stage. Voluntary reductions in use	Initiate public awareness of predicted water shortage and encourage conservation	Encourage voluntary measures to decrease “normal” demand up to 15%
Moderately Restricted Water Supplies Up to 30% Total Supply Reduction	Drought Stage 2 – Voluntary Phase for water use reductions and potential subsequent Mandatory Phase with restrictions on use.	Increase public understanding of worsening water supply conditions, encourage voluntary conservation measures, and enforce some mandatory conservation measures	Encourage some voluntary measures and enforce mandatory measures and implement water rationing to decrease “normal” demand up to 30% Drought surcharge enacted (potential in-house trigger and board action)
Severely Restricted Water Supplies Up to 50% Total Supply Reduction	Drought Stage 3 – Mandatory restrictions (severe prohibitions) on use	Ensure that water use is limited to health and safety purposes	Enforce extensive restrictions on water use and implement water rationing to decrease demand up to 50% of “normal” demand

DRAFT Drought Ditch Operation Guidelines

CRAWFORD DTICH SYSTEM

➤ **North Fork Segment**

Water Source – Direct diversion from the North Fork of the Cosumnes River.

Customers – There are several customers along this segment with agricultural pursuits that could be in jeopardy during a drought. They will need to share the limited water supply that would be available. EID should convene a community meeting for these customers to discuss rationing water during times of reduced supply.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demand by up to 10%. Convene a North Fork Segment customer meeting to discuss how to share the reduced water supply. Warn customers of possible water outages due to lack of supply. Restate the conditions of ditch service.

Drought Stage 2 – Send second notification that mandatory measures are now in effect, and water rationing will be necessary to decrease demand by up to 30% or more, depending on the water supply available from the North Fork of the Cosumnes River. Advise of possible water outage due to lack of supply. Restate the conditions of ditch service.

Drought Stage 3 – Send third notification that severe prohibitions on use are now in effect. Water rationing will be necessary to decrease demand by 50% or more, depending on the water supply available from the North Fork of the Cosumnes River.

➤ **Camp Creek Segment**

Water Source – North Fork Cosumnes River delivered through the North Fork Segment.

Customers – There are only two customers on this segment, and they only have lawns to water. They should be subject to the same restrictions as the rest of our domestic customers, unless there is no water available, and then they are subject to an outage.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demands by up to 10%. Advise customers of possible water outage due to lack of supply. Restate the conditions of ditch service.

Drought Stage 2 – Send second notification that there is a pending - or existing - water outage due to a lack of water supply available from the North Fork Segment of the Crawford Ditch. Restate the conditions of ditch service.

Drought Stage 3 – Send third notification, if needed, that a water outage now exists due to a lack of water supply from the North Fork Segment of the Crawford Ditch.

DRAFT Drought Ditch Operation Guidelines

➤ **Clear Creek Segment**

Water Source – Direct diversion from flow in Clear Creek, which is supplemented during the summer by releases from Sly Park’s Jenkinson Lake. These releases will be ramped down to a minimum of 1 cfs during drought conditions. Of this 1 cfs, there is a requirement to bypass 0.5 cfs at the Clear Creek diversion structure for instream flows.

Customers – There are numerous customers that use the water for irrigation and livestock, but there are no agricultural uses. Ditch operators could physically restrict their take from the ditch if each customer were metered. Hydro will pursue, through the CIP process, the installation of saddle, paddle wheel meters that can be easily pulled and cleaned. These meters could be installed on gravity outlet pipes (downhill services) or pumps (uphill services). The CIP would be used to make these improvements, and then the meters could be used to monitor actual usage before and during a drought.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demands by up to 10%. Notify customers that supplemental water from Jenkinson Lake used to support ditch operations will be restricted during a Drought Stage 2 condition, and will not be available at all during a Drought Stage 3 condition. Advise customers of possible water outages due to a lack of water supply in Clear Creek. Restate the conditions of ditch service.

Drought Stage 2 – Send second notification that mandatory measures are now in effect and there is a pending - or existing - outage due to a lack of water supply in Clear Creek. Notify customers that supplemental water from Jenkinson Lake used to support ditch operations is restricted during a Drought Stage 2 condition. Restate the conditions of ditch service.

Drought Stage 3 – Send third notification that severe prohibitions of use are now in effect and there is a pending - or existing - outage due to a lack of water supply in Clear Creek. Notify customers that water from Jenkinson Lake is not available to support ditch operations during a Drought Stage 3 condition. Restate the conditions of ditch service.

➤ **East Diamond Ditch**

Water Source – Direct diversions from Squaw Hollow Creek, and any tail water available from the Clear Creek Segment of the Crawford Ditch.

Customers – There are approximately 15 customers on this ditch and there are no meters. Customers receive water through either open-faced weirs, small pumps or private gravity flow waterlines. Ditch operators could physically restrict their take from the ditch if each customer were metered. Hydro will pursue, through the CIP process, the installation of saddle, paddle wheel meters that can be easily pulled and cleaned. These meters could be installed on gravity outlet pipes (downhill services) or pumps

DRAFT Drought Ditch Operation Guidelines

(uphill services). The CIP would be used to make these improvements, and then the meters could be used to monitor actual usage before and during a drought.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demands by up to 10%. Notify customers that supplemental water from Jenkinson Lake used to support ditch operations will be restricted during a Drought Stage 2 condition, and will not be available at all during a Drought Stage 3 condition. Advise customers of possible water outages due to a lack of water supply from Squaw Hollow Creek and Clear Creek. Restate the conditions of ditch service.

Drought Stage 2 – Send second notification that mandatory measures are now in effect and there is a pending - or existing - outage due to a lack of water supply from Squaw Hollow Creek and the Clear Creek Segment of the Crawford Ditch. Notify customers that supplemental water from Jenkinson Lake used to support ditch operations is restricted during a Drought Stage 2 condition. Restate the conditions of ditch service.

Drought Stage 3 – Send third notification that severe prohibitions of use are now in effect and there is a pending - or existing - outage due to a lack of water supply from Squaw Hollow Creek and the Clear Creek Segment of the Crawford Ditch. Notify customers that water from Jenkinson Lake is not available to support ditch operations during a Drought Stage 3 condition. Restate the conditions of ditch service.

ODLIN DITCH

Water Source – Potable water from a blow-off that travels through a series of pipes, open ditch, natural drainage, a creek bed, and more pipes.

Customers – There are only three customers and they use the water for lawn or garden irrigation. There are no agricultural uses on this ditch.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demands by up to 10%. Notify customers that the treated water supply used to support ditch operations will be restricted by 30% during a Drought Stage 2 condition, and will not be available at all during a Drought Stage 3 condition. Advise customers of a possible outage due to a lack of water supply. Restate the conditions of ditch service.

Drought Stage 2 – Send second notification that mandatory measures to decrease demands are now in effect, and EID is restricting the treated water supply used to support ditch operations by 30%. Advise customers of a pending - or existing - outage due to a lack of water supply. Notify customers that the treated water supply will not be available at all to support ditch operations during a Drought Stage 3 condition. Restate the conditions of ditch service.

Drought Stage 3 – Send third notification that severe prohibitions on use are now in effect. Notify customers that the treated water supply is not available to support ditch

DRAFT Drought Ditch Operation Guidelines

operations during a Stage 3 drought condition. Advise customers of an outage due to a lack of water supply. Restate the conditions of ditch service.

MISSOURI FLAT DITCH

Water Source – Potable water from two blow-offs, goes through individual meters and into private pipes.

Customers – There are three customers on this ditch. Water is used to fill a pond and irrigate lawns. There are no agricultural uses on this ditch.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demands by up to 10%. Notify customers that the treated water supply used to support ditch operations will be restricted by 30% during a Drought Stage 2 condition, and will not be available at all during a Drought Stage 3 condition. Advise customers of a possible outage due to a lack of water supply. Restate the conditions of ditch service.

Drought Stage 2 – Send second notification that mandatory measures to decrease demands are now in effect, and EID is restricting the treated water supply used to support ditch operations by 30%. Advise customers of a pending outage due to a lack of water supply. Notify customers that the treated water supply will not be available at all to support ditch operations during a Drought Stage 3 condition. Restate the conditions of ditch service.

Drought Stage 3 – Send third notification that severe prohibitions on use are now in effect. Notify customers that the treated water supply is not available to support ditch operations during a Stage 3 drought condition. Advise customers of an outage due to a lack of water supply. Restate the conditions of ditch service.

GOLD HILL DITCH

Water Source – Potable water is metered from a blow-off and flows down a draw or creek bed where it is diverted by private property owners. EID's responsibility ends at the metered blow-off.

Customers – There are five customers served as described above. There are no agricultural uses by these customers.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demands by up to 10%. Notify customers that the treated water supply used to support ditch operations will be restricted by 30% during a Drought Stage 2 condition, and will not be available at all during a Drought Stage 3 condition. Advise customers of a possible outage due to a lack of water supply. Restate the conditions of ditch service.

DRAFT Drought Ditch Operation Guidelines

Drought Stage 2 – Send second notification that mandatory measures to decrease demands are now in effect, and EID is restricting the treated water supply used to support ditch operations by 30%. Advise customers of a pending - or existing - outage due to a lack of water supply. Notify customers that the treated water supply will not be available at all to support ditch operations during a Drought Stage 3 condition. Restate the conditions of ditch service.

Drought Stage 3 – Send third notification that severe prohibitions on use are now in effect. Notify customers that the treated water supply is not available to support ditch operations during a Stage 3 drought condition. Advise customers of an outage due to a lack of water supply. Restate the conditions of ditch service.

MAIN DITCH

➤ Upper Main Ditch

Water Source – Diversions from Forebay Reservoir and the Project 184 system.

Customers – There are three customers on this segment, and two of the three services are metered. The third customer uses the water year-round in his house, but not for outdoor irrigation (very low usage). There is no meter to this service so we would be unable to restrict his usage – we can only ask for conservation.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demands by up to 10%. Notify customers that the Project 184 water supply used to support ditch operations will be restricted by 30% during a Drought Stage 2 condition, and will not be available at all during a Drought Stage 3 condition. Advise customers of a possible outage due to a lack of water supply. Restate the conditions of ditch service.

Drought Stage 2 – Send second notification that mandatory measures to decrease demands are now in effect, and EID is restricting the Project 184 water supplies used to support ditch operations by 30%. Advise customers of a possible outage due to a lack of water supply, as the Project 184 water supply will not be available at all to support ditch operations during a Drought Stage 3 condition. Restate the conditions of ditch service.

Drought Stage 3 – Send third notification that severe prohibitions on use are now in effect. Notify customers that Project 184 water supplies are not available to support ditch operations during a Stage 3 drought condition. Advise customers of an outage due to a lack of water supply. Restate the conditions of ditch service.

DRAFT Drought Ditch Operation Guidelines

➤ Lower Main Ditch

Water Source – Blow-offs and air release valves from the potable water system.

Customers – All of the customers on this segment are served through individual meters. There are numerous agricultural customers.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demands by up to 10%. Notify customers that the treated water supply used to support ditch operations will be restricted by 30% during a Drought Stage 2 condition, and will not be available at all during a Drought Stage 3 condition. Advise customers of a possible outage due to a lack of water supply. Restate the conditions of ditch service.

Drought Stage 2 – Send second notification that mandatory measures to decrease demands are now in effect, and EID is restricting the treated water supply used to support ditch operations by 30%. Advise customers of a possible outage due to a lack of water supply. Notify customers that the treated water supply will not be available at all to support ditch operations during a Drought Stage 3 condition. Restate the conditions of ditch service.

Drought Stage 3 – Send third notification that severe prohibitions on use are now in effect. Notify customers that the treated water supply is not available to support ditch operations during a Stage 3 drought condition. Advise customers of an outage due to a lack of water supply. Restate the conditions of ditch service.

JAMES DITCH

Water Source – Jenkinson Lake and Project 184 through direct connections to the potable water system

Customers – All of the customers are served through individual meters.

Drought Stage 1 – Send first notification to encourage voluntary measures to decrease demands by up to 10%. Notify customers that the treated water supply used to support ditch operations will be restricted by 30% during a Drought Stage 2 condition, and will not be available at all during a Drought Stage 3 condition. Advise customers of a possible outage due to a lack of water supply. Restate the conditions of ditch service.

Drought Stage 2 – Send second notification that mandatory measures to decrease demands are now in effect, and EID is restricting the treated water supply used to support ditch operations by 30%. Advise customers of a possible outage due to a lack of water supply. Notify customers that the treated water supply will not be available at all to support ditch operations during a Drought Stage 3 condition. Restate the conditions of ditch service.

DRAFT Drought Ditch Operation Guidelines

Drought Stage 3 – Send third notification that severe prohibitions on use are now in effect. Notify customers that the treated water supply is not available to support ditch operations during a Stage 3 drought condition. Advise customers of an outage due to a lack of water supply. Restate the conditions of ditch service.

Follow-up questions and ideas:

1. Should the Drought Stage 1 cutbacks for ditches be mandatory rather than voluntary restriction because it is a ditch irrigation service?
2. We need to consider that if we reduce deliveries to ditch customers that pay for a continuous rate of flow (i.e. 1 miners inch), do they get a refund for receiving less than this flow (i.e. 30% less or no water at all)?
3. The billings for all customers would need to be reduced if a customer ordered a certain amount of water (say 40 miners inches) and we cut them off part way through the season.
4. We may want to offer seasonal ditch customers an AMI or Retail account for year round metered service if they are off the potable system anyway. Then they wouldn't be subject to the ditch outages. This is especially true for the James Ditch.

APPENDIX F

Drought Stage Guidance Comparison Summary and Water Shortage Guidance Tables

**Summarized Relevant Water Shortage and Drought Policies
for El Dorado County Water Agency and El Dorado Irrigation District**

Agency	Current Policy																					
	El Dorado Irrigation District (EID)				El Dorado County Environmental Management Department	El Dorado County Water Agency (EDCWA)	Department of Water Resources (DWR)		California Office of Emergency Services	Governor's Advisory Drought Planning Panel					United States Bureau of Reclamation (USBR)					United States Army Corps of Engineers (USACE)		
	Stage 1 - Water Alert	Stage 2 - Water Warning	Stage 3 - Water Emergency	Stage 4 - Critical Water Emergency	(NOTE: Information gathering in progress.)	(NOTE: There are no current EDCWA drought policies.)	Urban Water Management Plan	Long-term drought preparedness planning	Water Supply Interruption Action Plan	Tier 1 Critical Water Shortage Reduction Marketing Program	Tier 2 Critical Water Shortage Reduction Marketing Program	Tier 3 Critical Water Shortage Reduction Marketing Program	Assistance to small water systems and homeowners in rural counties	Development of local agency Integrated Water Management Plans	Water Management Plan Guidelines	Ag and M&I Shortage Allocations	Develop a strategy	Stage 1 - Minimal	Stage 2 - Moderate	Stage 3 - Severe	Stage 4 - Critical	Drought Response Plan Development
EID	R	R	R	R	S		R	S	S	S	S	S	S	S	R	R	S	S	S	S	S	S
EDCWA					S				S	S	S	S	S									S

KEY
R = Required
S= Suggested
= Not Applicable

**Relevant Water Shortage and Drought Policies
for El Dorado County Water Agency and El Dorado Irrigation District**

Agency	Current Policy	Current Procedure	
		Action	Schedule
PURVEYOR LEVEL			
EID	Stage 1 - Water Alert	Reduce water usage by 0%-5%. Voluntary discontinuation of street/sidewalk cleaning.	See Table 1 (Water Matrix) from EID 4-Stage Water Supply Matrix and Water Shortage Response Measures (1995)
EID	Stage 2 - Water Warning	Reduce water usage by 5%-10%. Mandatory prohibition of street/sidewalk cleaning and construction water use. Voluntary discontinuation fo washing cars, watering lawns, refilling/filling of pools.	
EID	Stage 3 - Water Emergency	Reduce water usage by 10%-20%. Mandatory prohibition of washing cars, watering lawns, refilling/filling pools.	
EID	Stage 4 - Critical Water Emergency	Reduce water usage by 20%-30%. Mandatory prohibition of new/proposed agricultural plantings.	
COUNTY LEVEL			
El Dorado County Environmental Management Department	(NOTE: Information gathering in progress.)	(NOTE: Spoke with Greg Stanton at El Dorado County Environmental Management Department on 08/15/06. Before providing information on County policies/regulations, Greg would like to discuss with his staff.)	
El Dorado County Water Agency (EDCWA)	(NOTE: There are no current EDCWA drought policies.)		

**Relevant Water Shortage and Drought Policies
for El Dorado County Water Agency and El Dorado Irrigation District**

Agency	Current Policy	Current Procedure	
		Action	Schedule
STATE LEVEL			
Department of Water Resources (DWR)	Urban Water Management Plan	<p>Include a water shortage contingency analysis in UWMPs and include each of the following elements:</p> <p>(a) Stages of action (including up to a 50% water supply reduction) and an outline of specific water supply conditions for each stage.</p> <p>(b) Estimate of the min. water supply available during each of the next 3 water years based on the driest 3-year historic sequence.</p> <p>(c) Actions to prepare for and implement during a catastrophic interruption of water supplies.</p> <p>(d) Mandatory prohibitions against specific water use practices during water shortages.</p> <p>(e) Consumption reduction methods in the most restrictive stages.</p> <p>(f) Penalties or charges for excessive use, where applicable.</p> <p>(g) Analysis of the impacts of each of the actions and conditions described in subdivisions (a) to (f), inclusive, on the revenues and expenditures, and proposed measures to overcome those impacts.</p> <p>(h) Draft water shortage contingency resolution or ordinance.</p> <p>(i) Mechanism for determining actual reductions in water use pursuant to the urban water shortage contingency analysis.</p>	Every five years
DWR	Long-term drought preparedness planning	<p>1) Seek additional funding or partnerships to support DWR's basic water measurement programs</p> <p>2) Update and publish DWR's water well standards</p> <p>3) Develop a fact sheet and web page to ID county agencies administering well standards</p> <p>4) Closely review shortage contingency elements of UWMPs</p> <p>5) Develop an internal database-backed website for extracting information from UWMPs</p> <p>6) Continue efforts to site more CIMIS weather stations in urban areas</p> <p>7) Survey some of CA's larger urban areas to determine the extent to which the Model Water Efficient Landscape Ordinance is being implemented.</p> <p>8) Identify and fund research in the areas of long-range weather forecasting, global climate change, and paleoclimatology</p>	<p>1) January of first water year: Submit funding request in Governor's May budget revision for drought water bank in the programmatic EIR and for placing additional mobile irrigation management labs in the field</p> <p>2) Spring of first water year: Promote CIMIS through workshops and media outreach, and begin developing fact sheets and related information to respond to public and news media inquiries</p> <p>3) Summer of first water year: Begin holding public workshops on well construction fundamentals and the DWR's well standards, targeting rural counties with large numbers of individual residences on wells</p> <p>4) Near start of second water year: (a) Evaluate water supply and triggers. (b) If warranted, begin enhanced education and outreach program. (c) Evaluate staff resources available for processing water bank contracts and contracts for other wheeling of non-SWP water. (d) Evaluate need for any new legislation to address drought-related conditions.</p>
California Office of Emergency Services	Water Supply Interruption Action Plan	<p>1) Normal Conditions: No water use reduction needed.</p> <p>2) Water Alert: A 5% or greater reduction in water usage.</p> <p>3) Water Warning: A 15% or greater reduction in water usage.</p> <p>4) Water Crisis: A 30% or greater reduction in water usage.</p> <p>5) Water Emergency: A 50% or greater reduction in water usage.</p>	
Governor's Advisory Drought Planning Panel	Tier 1 Critical Water Shortage Reduction Marketing Program	Water Shortage Preparedness: Implement water use efficiency measures, develop local facilities to enable water transfers, and develop local groundwater management programs. Develop guidelines/criteria/action plans to prepare for Tier 2 and 3 occurrences. Begin a reserve fund to cover participation in the program.	CALFED Stage 1
Governor's Advisory Drought Planning Panel	Tier 2 Critical Water Shortage Reduction Marketing Program	Purchasing Options and Allocating Water: Make a declaration of probable impending critical water shortages absent a program purchase and demonstrate that resources are being maximized to purchase water	
Governor's Advisory Drought Planning Panel	Tier 3 Critical Water Shortage Reduction Marketing Program	Water Shortage Emergency: Coordinate with State regarding financial assistance for emergency water acquisitions, including water hauling, pipeline construction, or well drilling.	
Governor's Advisory Drought Planning Panel	Assistance to small water systems and homeowners in rural counties	Proposed State-funded DWR-developed program component: Development of a technical assistance/education program targeted to rural homeowners and small domestic water systems relying on self-supplied groundwater, to be implemented in consultation with rural county environmental health departments, including series of workshops designed to educate homeowners with private wells about well construction and maintenance fundamentals. Development of a website containing information on State and County well construction requirements, sources of groundwater level and well yield data, and State and County contacts for obtaining additional information.	Proposed State-funded DWR-developed program component: At time of Governor proposal and subsequent Legislature approval
Governor's Advisory Drought Planning Panel	Development of local agency Integrated Water Management Plans	Proposed DWR/other CALFED agencies-funded program: DWR/other CALFED agencies to work in partnership with local water agencies to assist them in developing plans to facilitate integrated management of supplies for agricultural, urban, and environmental purposes.	Proposed DWR/other CALFED agencies-funded program: At time of DWR allocation of funds (at least \$2 million per year) to support proposed program.

**Relevant Water Shortage and Drought Policies
for El Dorado County Water Agency and El Dorado Irrigation District**

Agency	Current Policy	Current Procedure	
		Action	Schedule
FEDERAL LEVEL			
United States Bureau of Reclamation (USBR)	Water Management Plan Guidelines	Attach to the USBR Water Management Plan a copy of the agricultural and/or urban water shortage policies, drought plan, or any similar document. Describe how reduced water supplies, including hardship water, are allocated. Describe the policies that address wasteful use of water and describe enforcement methods.	
USBR	Ag and M&I Shortage Allocations	<p>M&I Shortage Policy - Central Valley Project:</p> <p>1) Decrease ag water supplies to 75% of contractual water supply before M&I water supplies begin taking shortages.</p> <p>2) Then ag and M&I shortages ratchet down % by % until M&I water reaches 75% of its historic use and ag water is at 50% of its contractual water supply.</p> <p>3) When the M&I's 75% reliability sets in, M&I will remain at 75% of its historic use, and reduce ag water until ag supplies reach 25% of their contract water supply. Evaluate CVP water supply availability, public health and safety levels, hardship water for agricultural demands, etc.</p> <p>4) When ag water supplies are reduced to 25%, further reduce M&I water supplies.</p>	
USBR	Develop a strategy	<p>Preparing for, minimizing, and responding to water shortages:</p> <p>1) Establish triggers for a water shortage response plan and actions to be taken before and during a water shortage. Balance supply and demand.</p> <p>2) Develop a water shortage strategy with stages, select appropriate drought mitigation measures, match water shortage mitigation actions to strategy stages (i.e., supply augmentation methods, demand reduction methods,</p> <p>3) When a water shortage is imminent, implement strategy: evaluate water saved by staged reductions and select stage</p> <p>4) Monitor production and use</p> <p>5) Implement public outreach strategy and involve the media</p> <p>6) Analyze revenue and expenditure impacts</p>	
USBR	Stage 1 - Minimal	Voluntary reductions to decrease "normal" demand by 5-10%.	
USBR	Stage 2 - Moderate	Some mandatory measures.	15-25% Total Supply Reduction
USBR	Stage 3 - Severe	Water rationing.	25-35% Total Supply Reduction
USBR	Stage 4 - Critical	Water rationing and extensive restrictions on water use to decrease demand by 50% of the "normal" demand.	35-50% Total Supply Reduction
United States Army Corps of Engineers (USACE)	Drought Response Plan Development	<p>Include in Drought Response Plan the following elements:</p> <p>1) Triggers</p> <p>2) Forecasts</p> <p>3) Monitoring</p> <p>4) Enforcement</p> <p>5) Public affairs strategy</p> <p>6) Management measures</p> <p>7) Coordination mechanism</p>	

APPENDIX G

EID Reliability

EID Reliability - No Plan VS Current Plan

Table 1. EID Current Plan Reliability

Year	Description	Reliability based on historical record (1922-2004)		Reliability based on design drought conditions (76-77-77 hydrology)	
		No plan (no drought plan or demand reduction)	Current (based on Sly Park levels)	No plan (no drought plan or demand reduction)	Current (based on Sly Park levels)
2004	Reliability (%)	99.5	99.9	88.9	100
	% months drought declared	0 ^a	7.2	0 ^a	N/A ^b
2010	Reliability (%)	96.8	99.5	75.0	80.6
	% months drought declared	0 ^a	13.5	0 ^a	N/A ^b
2020	Reliability (%)	91.1	95.6	36.1	44.4
	% months drought declared	0 ^a	25.5	0 ^a	N/A ^b
2030	Reliability (%)	80.8	88.9	30.6	33.3
	% months drought declared	0 ^a	39.3	0 ^a	N/A ^b

Notes:

1. Assumes Sly Park reservoir supplies El Dorado Hills water users only when it has at least 10,000 ac-ft of storage.

2. Based on SVM 061307 version.

^a Since this alternative has no drought triggers, no drought policy is called in any month

^b Percent time in drought for design drought conditions is not available (N/A).

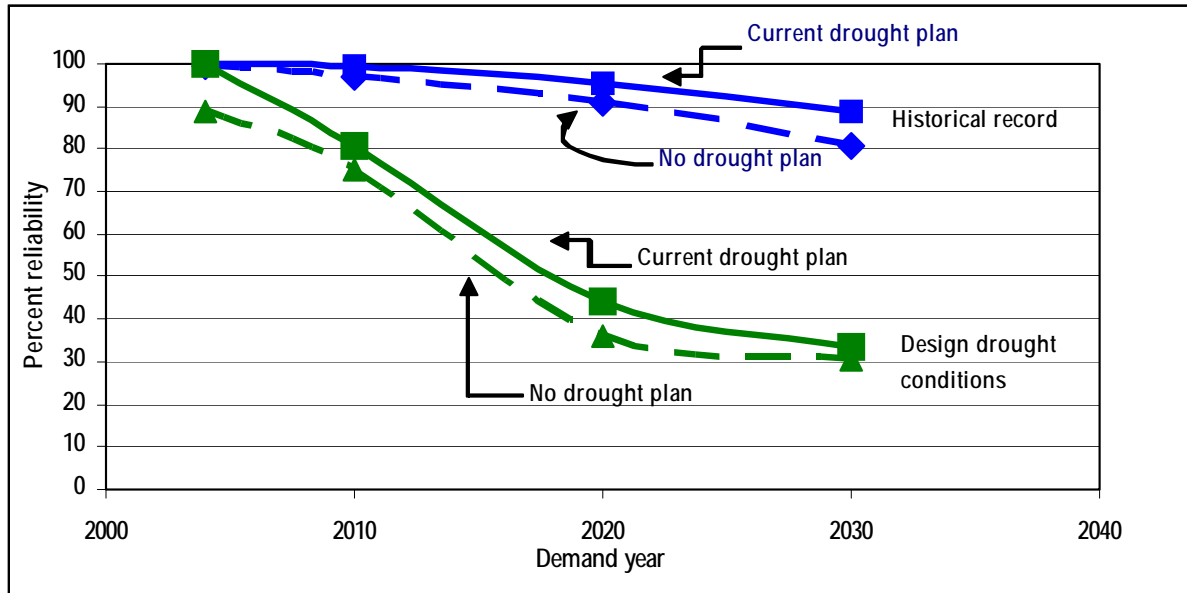


Figure 1. EID Reliability

EID Reliability - No Plan, Current, Experimental and SRI Trigger Plan Comparison

Table 2. EID Trigger Plan Summary

Year	Description	Trigger Plan			
		No plan (no drought plan or demand reduction)	Current (based on Sly Park levels)	Experimental (based on Sly Park levels, DWR water year, Sly Park inflows)	SRI (based on ENSO, reservoir levels, worst case expected inflows, projected normal demands)
2004	Reliability (%)	99.5	99.9	100	100
	% months drought declared	0 ^a	7.2	10.4	9.3
2010	Reliability (%)	96.8	99.5	100	100
	% months drought declared	0 ^a	13.5	16.4	9.3
2020	Reliability (%)	91.1	95.6	98.8	97.7
	% months drought declared	0 ^a	25.5	24.1	21.9
2030	Reliability (%)	80.8	88.9	93.8	88.4
	% months drought declared	0 ^a	39.3	32.3	30.7

1. Reliability is based on the historical record (1922-2004).

2. Assumes Sly Park reservoir supplies El Dorado Hills water users only when it has at least 10,000 acre-feet of storage.

3. Based on SVM 072507 version.

4. Bolded values represent best value.

5. The SRI indicators and triggers were optimized for 2004 and 2010 demands.

6. Reliability less than 100% means that additional curtailments would be necessary beyond whatever stage 3 measures are used.

^a Since this alternative has no drought triggers, no drought policy is called in any month.

EID Reliability – Drought Impact Avoidance Project Comparison

Table 3. EID Drought Impact Avoidance Project Summary					
Year	Projects	No climate change		Worst-case climate change scenario	
		Reliability %	% months drought declared	Reliability %	% months drought declared
2010	No project	100	9.3	99.4	22.8
	Water Conservation (WC)	100	6.9	99.4	14.4
	PL101-514 & Water Conservation (PL&WC)	100	6.9	99.4	13.8
2030	No project	88.4	30.7	97.6	45.5
	PL101-514 & Water Conservation (PL&WC)	92.9	21.4	95.8	39.9
	Water Loss Reduction & PL&WC	94.3	21.0	95.8	39.6
	Groundwater Banking & PL&WC	97.4	21.4	98.4	39.9
	White Rock Diversion & PL&WC	100	21.4	99.4 ^a	39.9 ^a
	Sly Park Flashboards & PL&WC	93.0	20.3	96.0	38.9
	Alder Creek Reservoir & PL&WC	99.4	10.5	98.1	31.7
	Texas Hill Reservoir & PL&WC	99.2	13.9	97.9	33.0
	Capps Crossing Reservoir & PL&WC	99.8	8.1	98.4	28.8

Notes:

1. Reliability is based on the historical record (1922-2004) and SRI trigger plan.
 2. Assumes Sly Park reservoir supplies El Dorado Hills water users only when it has at least 10,000 acre-feet of storage.
 3. Based on SVM 061307 version.
 4. The SRI indicators and triggers were optimized for 2004 and 2010 demands.
 5. Reliability less than 100% means that additional curtailments would be necessary beyond whatever Stage 3 measures are used.
 6. Worst case climate scenario is PCM2100 – a cooler, drier climate estimate. Under this scenario some projects increase EID reliability, but drought is declared more frequently.
- ^a This scenario is shown in SVM screen shot Figure 2-4.

APPENDIX H

Drought Response Water Use Policies and Applied Stages

DRAFT
PROPOSED EID Water Use Policies and Stages Applied

<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Water Rationing Stages 1 - Introductory Voluntary (up to 15%) 2 - Voluntary and Mandatory Phase - Community Cooperation (up to 30%) 3 - Mandatory - Allotments with Severe Penalties (up to 50%) </div>		Water Use Policies and Stages Applied																																							
		Water Shortage Customer and Stage Applied (by customer category account type)																																							
		Existing Residential									New Residential									Existing CII						New CII						Agriculture and Other Irrigation									
		Potable			Dual			Potable			Dual			Potable			Dual			Potable			Dual			Potable			Dual			Small Farms			Domestic			Com. w IMS			Com. no IMS
Water Use	Policy	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
Filling swimming pools and spas	Voluntary: Empty swimming pools are not to be filled with potable EID water	X			X									X			X												X			X									
	Prohibited: Empty swimming pools are not to be filled with potable EID water		X			X		X			X			X			X			X			X			X			X			X									
Washing vehicles and boats	Voluntary: No washing of vehicles (automobiles, recreational vehicles, trailers, etc.) or boats with EID potable water	X			X			X			X			X			X			X			X			X			X			X									
	Prohibited: No washing of vehicles (automobiles, recreational vehicles, trailers, etc.) or boats with EID potable water		X			X		X			X			X			X			X			X			X			X			X									
	Prohibited: No washing of vehicles (automobiles, recreational vehicles, trailers, etc.) or boats with EID potable or recycled water						X						X						X						X																
Indoor plumbing (fixtures)	Voluntary: Incentive programs implemented to strongly encourage water savings.	X			X			X			X												X			X			X												
	Rebates programs strongly offered. Commercial HET's, etc.													X			X			X																					
Cleaning and construction purposes, including but not limited to dust control, settling of backfill, flushing of plumbing lines, and washing of equipment and buildings	Voluntary: Seek sources for all portable construction water tanks other than potable EID water for dust control, earthwork, road construction, etc.	X			X			X			X			X			X			X			X			X			X			X									
	Prohibited: Seek sources for all portable construction water tanks other than potable EID water for dust control, earthwork, road construction, etc. Exclusion for asbestos mitigation.		X			X		X			X			X			X			X			X			X			X			X									
	Prohibited: Seek sources for all portable construction water tanks other than potable and recycled EID water for dust control, earthwork, road construction, etc. Exclusion for asbestos mitigation.						X						X						X						X																
Ornamental fountains and ponds except when water is re-circulated (Note: A sign is required to be located adjacent to the fountain stating that the water in the fountain is being re-circulated)	Voluntary: Ponds, lakes, and other non-irrigation water features shall not be filled with potable water.	X			X					X			X			X			X			X			X			X			X			X			X				
	Prohibited: Ponds, lakes, and other non-irrigation water features shall not be filled with potable water.		X			X		X					X	X					X	X					X			X			X			X			X				
	Prohibited: Ponds, lakes, and other non-irrigation water features shall not be filled with potable or recycled water.						X						X						X				X	X																	

Note: "Dual" means customer is served both potable and recycled water.

DRAFT
PROPOSED EID Water Use Policies and Stages Applied

<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Water Rationing Stages 1 - Introductory Voluntary (up to 15%) 2 - Voluntary and Mandatory Phase - Community Cooperation (up to 30%) 3 - Mandatory - Allotments with Severe Penalties (up to 50%) </div>		Water Use Policies and Stages Applied																																												
		Water Shortage Customer and Stage Applied (by customer category account type)																																												
		Existing Residential									New Residential									Existing CII									New CII									Agriculture and Other Irrigation								
		Potable			Dual			Potable			Dual			Potable			Dual			Potable			Dual			Potable			Dual			Small Farms			Domestic			Com. w IMS			Com. no IMS					
Water Use	Policy	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3						
Cleaning hard surfaces such as sidewalks, driveways, and parking	Prohibited: Prohibit washing of driveways, parking lots, and other surfaces with potable EID water. (Note: Sweeping will be encouraged as an alternative.)	X			X			X			X			X			X			X			X			X			X			X														
Landscape watering	Voluntary: all outside watering, including garden, lawn, landscape, domestic and pasture irrigation, parks, golf courses, school grounds, and public grounds shall occur between 6PM to 9AM	X			X						X			X			X						X			X			X																	
	Prohibited: all outside watering, including garden, lawn, landscape, domestic and pasture irrigation, parks, golf courses, school grounds, and public grounds shall occur between 6PM to 9AM		X			X		X				X														X			X																	
	Prohibited: all outside watering, including garden, lawn, landscape, domestic and pasture irrigation, parks, golf courses, school grounds, and public grounds shall not be watered with potable and recycled EID water					X						X														X			X																	
	Prohibited: all outside watering, including garden, lawn, landscape, domestic and pasture irrigation, parks, golf courses, school grounds, and public grounds shall occur between 6PM to 9AM. 70% of water budget ok..													X			X			X						X																				
	Prohibited: all outside watering, including garden, lawn, landscape, domestic and pasture irrigation, parks, golf courses, school grounds, and public grounds shall not be watered with potable EID water. Parks, school grounds and public grounds ok to use 70%.			X				X							X			X		X						X																				
Landscape development	Voluntary: Submit to Mandatory Landscape Review Process	X			X	X					X	X		X			X						X			X			X																	
	Mandatory Landscape Review														X									X																						
	Prohibited: Landscape Development		X					X				X		X												X	X		X																	
	Prohibited: Irrigation of new landscape development with potable and recycled EID water.						X									X																														
Gutter flooding - water runoff caused by applying more water than soil can absorb	Prohibited: Penalties are applicable under the water waste ordinance. (Prohibition of nonessential uses per resolution 77-23 January 11, 1977.)	X			X			X			X			X			X			X			X			X			X																	
Roof cooling	Prohibited: Penalties are applicable under the water waste ordinance. (Prohibition of nonessential uses per resolution 77-23 January 11, 1977.)	X			X			X			X			X			X			X			X			X			X																	
Swamp coolers, watering of galvanized roofs or water to cool refrigerants without closed-loop system	Voluntary: Under water waste ordinance. (Prohibition of nonessential uses per resolution 77-23 January 11, 1977.) Note: Incentives offered. Exclusion for elderly and low-income.					X								X			X									X			X																	
	Prohibited: Under water waste ordinance. (Prohibition of nonessential uses per resolution 77-23 January 11, 1977.) Note: Incentives offered. Exclusion for elderly and low-income.	X																																												

DRAFT
PROPOSED EID Water Use Policies and Stages Applied

Water Use Policies and Stages Applied		Water Shortage Customer and Stage Applied (by customer category account type)																																							
		Existing Residential									New Residential									Existing CII						New CII						Agriculture and Other Irrigation									
		Potable			Dual			Potable			Dual			Potable			Dual			Potable			Dual			Small Farms			Domestic			Com. w IMS			Com. no IMS						
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3							
	<div style="border: 1px solid black; padding: 2px; width: fit-content;"> Water Rationing Stages 1 - Introductory Voluntary (up to 15%) 2 - Voluntary and Mandatory Phase - Community Cooperation (up to 30%) 3 - Mandatory - Allotments with Severe Penalties (up to 50%) </div>	Prohibited: Under water waste ordinance. (Prohibition of nonessential uses per resolution 77-23 January 11, 1977.) Note: No Incentives offered. Exclusion for elderly and low-income.	X			X			X			X			X			X			X			X			X			X											
Construction	Voluntary: Seek sources for all portable construction water tanks other than potable EID water for dust control, earthwork, road construction, etc.	X			X			X			X			X			X			X			X			X			X												
	Prohibited: Seek sources for all portable construction water tanks other than potable EID water for dust control, earthwork, road construction, etc. Exclusion for asbestos mitigation.	X			X			X			X			X			X			X			X			X			X												
	Prohibited: Seek sources for all portable construction water tanks other than potable and recycled EID water for dust control, earthwork, road construction, etc. Exclusion for asbestos mitigation.					X			X			X						X						X																	
Water meters	Prohibited: Prohibited: No service for new potable accounts		X						X						X			X			X			X			X			X											
Mist Systems	Prohibited	X			X			X			X			X			X			X			X			X			X												
Commercial Only Policies																																									
Eating Establishment Water Service	Prohibited: Water is not to be served to restaurant customers unless requested by customer. Table cards with drought notices required.													X			X			X			X																		
Cooling Towers (dolphin and Recirculating systems excluded)	Voluntary: Incentives to be offered.													X			X																								
	Prohibited. NO INCENTIVES OFFERED.													X			X			X			X																		
Agriculture Only Policies																																									
General Use	Recertify every 3 years that have 0.5 acres or more under production.																									X															
IMS Program	Surcharge if not followed.																																		X						
Growing Season use allotment	Voluntary awarded credit																																		X						
	Mandatory IMS participation. Penalties.																																			X					
	Mandatory and restricted IMS. Penalties																																				X				

APPENDIX I

Suggested EID Water Waste Prohibition

PROHIBITION NO. _____

**A PROHIBITION OF THE El Dorado Irrigation District INSTITUTING
WATER WASTE PROHIBITIONS**

SECTION 1. The **El Dorado Irrigation District** does hereby ordain as follows:

The <Code/Regulations> of the **El Dorado Irrigation District** hereby amended by adding Section _____ to _____, to read as follows:

“Section _____ - Water Waste Prohibitions

A. Purpose. The purpose of this Section is to promote water conservation and the efficient use of potable water furnished by the **El Dorado Irrigation District** by eliminating intentional or unintentional water waste when a reasonable alternative solution is available, and by prohibiting use of equipment which is wasteful.

B. Nonessential Uses. No customer of the **El Dorado Irrigation District** shall use or permit the use of potable water from the **El Dorado Irrigation District** for residential, commercial, institutional, industrial, agricultural, or other purpose for the following nonessential uses:

1. The washing of sidewalks, walkways, driveways, parking lots and other hard-surfaced areas by direct hosing, except as may be necessary to properly dispose of flammable or other dangerous liquids or substances, wash away spills that present a trip and fall hazard, or to prevent or eliminate materials dangerous to the public health and safety;
2. The escape of water through breaks or leaks within the customers plumbing or private distribution system for any substantial period of time within which such break or leak should reasonably have been discovered and corrected. It shall be presumed that a period of seventy-two (72) hours after the customer discovers such a break or leak or receives notice from the **El Dorado Irrigation District**, is a reasonable time within which to correct such break or leak or, as a minimum, to stop the flow of water from such break or leak;
3. Irrigation in a manner or to an extent which allows excessive runoff of water or unreasonable over-spray of the areas being watered. Every customer is deemed to have his water system under control at all times, to know the manner and extent of his water use and any run off, and to employ available alternatives to apply irrigation water in a reasonably efficient manner;
4. Washing cars, boats, trailers or other vehicles and machinery directly with a hose not equipped with a shutoff nozzle;
5. Water for non-recycling decorative water fountains;

6. Water for single pass evaporative cooling systems for air conditioning in all connections installed after < insert effective date of this ordinance > unless required for health or safety reasons;
7. Water for new non-recirculating conveyor car wash systems; and
8. Water for new non-recirculating industrial clothes wash systems.

C. Exempt Water Uses. All water use associated with the operation and maintenance of fire suppression equipment or employed by the **El Dorado Irrigation District** for water quality flushing and sanitation purposes shall be exempt from the provisions of this section.

D. Variances. Any customer of the **El Dorado Irrigation District** may make written application for a variance. Said application shall describe in detail why applicant believes a variance is justified.

1. The <manager or other authorized representative of the **El Dorado Irrigation District** > may grant variances for use of water otherwise prohibited by this section upon finding and determining that failure to do so would cause an emergency condition affecting the health, sanitation, fire protection or safety of the applicant or public; or, cause an unnecessary and undue hardship on applicant or public, including but not limited to, adverse economic impacts, such as loss of production or jobs.
2. The decision of the <manager or other authorized representative of the **El Dorado Irrigation District** > may be appealed to the Board of Directors by submitting a written appeal to the **El Dorado Irrigation District** within fifteen (15) calendar days of the date of the decision. Upon granting any appeal, the Board of Directors may impose any conditions it determines to be just and proper. Variances granted by the Board of Directors shall be prepared in writing and the Board of Directors may require the variance be recorded at applicant's expense.

E. Enforcement and Fees. Depending on the extent of the water waste the **El Dorado Irrigation District** may, after written notification to customer and a reasonable time to correct the violation as solely determined by the **El Dorado Irrigation District**, take some or all of the following actions. Penalties, fees and charges noted below shall be established by resolution of the **El Dorado Irrigation District**.

1. Written notice to the customer of the water waste violation including a specified period of time to correct the violation.
2. Personal contact with the customer at the address of the water service. If personal contact is unsuccessful, written notice of the violation including a date that the violation is to be corrected may be left on the premises, with a copy of the notice sent by certified mail to the customer.

3. The **El Dorado Irrigation District** may install a flow-restricting device on the service line.
4. The **El Dorado Irrigation District** may levy a water waste fee to the customer.
5. The **El Dorado Irrigation District** may cause termination of water service and the charge for same shall be billed to the customer. Except in cases of extreme emergency as solely determined by the <manager or other authorized representative of the **El Dorado Irrigation District** >, service shall not be reinstated until verified by the **El Dorado Irrigation District** that the violation has been corrected and all charges and fees have been paid.

SECTION II. SEVERABILITY

If any section, subsection, sentence, clause, phrase, or word of this prohibition is for any reason held to be invalid, the validity of the remaining portion of this prohibition shall not be affected.

SECTION III. ENVIRONMENTAL DETERMINATION

The **El Dorado Irrigation District** determines that this prohibition is a Class 7 categorical exemption under section 15307 of the California Environmental Quality Act, which exempts actions by regulatory agencies for protection of natural resources.

SECTION IV. EFFECTIVE DATE

This prohibition shall become effective (30) days after the date of adoption.

PASSED, APPROVED AND ADOPTED this ____ day of _____, 20__, by vote as follows:

AYES: _____
 NOES: _____
 ABSTAIN: _____
 ABSENT: _____

<PRESIDENT of BOARD>

ATTEST:

<CLERK or SECRETARY of BOARD>

APPENDIX J

Public Outreach Example Resources

Public Outreach

Source: U.S. Bureau of Reclamation, SCCAO Drought Handbook for M&I Water Contractors, April 2003.

Example Menu of Options for Public Outreach

Place a checkmark by the options that you will consider including in your public awareness campaign during a water shortage.

Menu of Options for Public Outreach	Stage
Bill Inserts for water bills	
Public service advertising – run for free by local media	
Paid Advertising – Newspaper	
Paid Advertising – Radio	
Paid Advertising – Television	
Paid Advertising – Movie Slides for local movie theaters	
Paid Advertising – Chamber of Commerce Newsletter	
District newsletter	
Classroom Presentations	
Water Shortage Pamphlet – mass distribution to all customers	
Water Shortage Website	
Public Workshops – Drought Survival – Water conservation	
Water Shortage Information Center	
Public Advisory Committee	
Displays in District Office	
Water efficient fixture rebates	
Water efficient fixture distribution	
Promote use of Greywater	
Drought Tolerant Plant Tagging Program at local nurseries	
Promoting CIMIS information	
Water Shortage Hotline	
Water Audits	
Displays in Public Libraries, at local schools, shopping malls, etc.	
Bus ads	
Billboards	
Promotional Items with a conservation message (mugs, rulers, stickers, pens)	

Source: Santa Barbara County Water Agency, 2001.

Checklist for Keeping the Media Involved

- ___ 1. Create a media list to ensure that all available local media are used – select an official representative at each radio station, newspaper, and television station to serve as a point of contact for water shortage information released from your district. See Worksheet below.
- ___ 2. Establish a public advisory committee
- ___ 3. Include public and media in the water shortage planning process
- ___ 4. Organize water shortage information meetings for the public and the media.
- ___ 5. Publish and distribute pamphlets on water conservation techniques and water shortage management strategies
- ___ 6. Organize workshops on water shortage related topics
- ___ 7. Prepare sample ordinances on water conservation
- ___ 8. Establish a water shortage information center
- ___ 9. Write reports for the media early in the course of the water shortage and prepare weekly press releases with current water shortage conditions
- ___ 10. Establish a list of authorities on water shortage that can be distributed to the media for further reference.
- ___ 11. Organize education activities for the media.
- ___ 12. Establish a budget for advertising water shortage programs
- ___ 13. Write reports for media early in the event
- ___ 14. Prepare reports on the efforts of the water district to conserve water – conjunctive use, system audits, meter retrofits, training for staff, etc.
- ___ 15. Establish or use an existing newsletter to provide an overview of water shortage activities, tips for conservation, articles showcasing local conservation efforts on the part of homeowners and businesses.
- ___ 16. Conduct press conferences as needed. Use on-location approach if photo opportunities exist (i.e., a local reservoir when reservoir is visibly low)

Media List

Use this table to create your media contact list. Be sure to include all media in your community.

Media List			
	Name	Email	Phone/Fax
TV Stations - include government access channels			
Print Media - include newspapers from local colleges and news clipping services			
Radio Stations			
Chambers of Commerce			
Political leaders			
Water Dist. Board			
County Sups			
City Council			
Assembly			
Congress			

Source: Santa Barbara County Water Agency, 2001.

APPENDIX K

Interim Agreement to Amend Terms and Conditions of the El Dorado Irrigation District Improvement District No. 97

**INTERIM AGREEMENT TO AMEND TERMS AND CONDITIONS OF EL
DORADO IRRIGATION DISTRICT IMPROVEMENT DISTRICT NO. 97**

This Interim Agreement is made effective this 17th day of October, 2005, by and between the El Dorado Irrigation District, a public agency organized and existing under the Irrigation District Law of the State of California, and all present and future property owners within the boundaries of Improvement District No. 97, as follows:

WHEREAS, upon the petition of affected property owners, the El Dorado Irrigation District ("District") adopted Resolution No. 74-147 on November 12, 1974, forming Improvement District No. 97 ("ID 97") pursuant to Sections 23600 and following of the California Water Code; and

WHEREAS, before adopting Resolution No. 74-147, the District prepared a Feasibility Report for ID 97 on September 4, 1974; and held a prior public hearing on September 24, 1974; and

WHEREAS, both the Feasibility Report and Resolution No. 74-147 state that the purpose of ID 97 "is to maintain the quality, beauty, and other intangible assets of the Clear Creek area by maintaining a certain minimum flow down the Clear Creek channel throughout the year"; and

WHEREAS, Resolution No. 74-147 states that the minimum flow shall be 5 cubic feet per second (cfs); that the water released to maintain the minimum flow is for aesthetic use only and not available to adjacent property owners for consumptive use; and that the improvement district shall be charged for water releases only when they are made specifically to meet minimum flow requirements in Clear Creek; that from time to time releases in Clear Creek will be discontinued to determine the amount of water flowing in Clear Creek that is available to satisfy riparian water right requirements; and that ID 97 property owners will be assessed equally, up to \$5 per parcel, and proportionate to Clear Creek frontage, in excess of \$5 per parcel, for the total annual costs of maintaining the minimum flow, subject to the conditions stated in Resolution No. 74-147 and summarized in this recital; and

WHEREAS, the feasibility report states that the District will install a flow gaging station, capable of measuring flow rates from 1 to at least 12 cfs, at the intersection of Clear Creek with Sly Park Road; that the District will monitor and log the flow at least once each week; and that the District will make necessary adjustments in its releases to Clear Creek; and

WHEREAS, the feasibility report states that if the ID 97 property owners desire a change in the minimum flow rate, they shall petition the Board of Directors of the District for a public hearing on the proposal; and further states that changes in the plan of operation or other features of the improvement district may be made as provided for under the Water Code; and

WHEREAS, Water Code Sections 23865 and 23879 require the assent of at least two-thirds of the property owners within an improvement district before additional work, additional lands, or additional assessments are added to an improvement district; and

WHEREAS, since August 2003, the following public meetings have been held regarding ID 97: a workshop of the District's Board of Directors on November 17, 2003; a public workshop at the Pleasant Valley Grange on January 26, 2004; and a public meeting of the District's Board of Directors on September 8, 2004; and

WHEREAS, as a result of these public meetings, the parties agree that the following facts are established as true and not subject to dispute:

- Until July 7, 2004, the District had not installed a flow gaging station, nor monitored Clear Creek flow at the Sly Park Road crossing, as specified in the feasibility report;
- The District has not discontinued Clear Creek releases from time to time to determine the amount of natural flow available for riparian users, as specified in Resolution 74-147;
- Since 1991, the District's releases to augment natural flow in Clear Creek have averaged 1 to 2 cfs, which at most times is unlikely to have produced or sustained a Clear Creek minimum flow of 5 cfs at the Sly Park Road crossing;
- Between 1982 and 1990, the District's average Clear Creek releases were substantially higher, often in the range of 5 cfs and at times up to 8 cfs;
- The change in the District's average Clear Creek releases coincides with improvements made to the water efficiency of Crawford Ditch, although this does not prove a causal link between the two events;
- There may have been multiple reasons, known and unknown, for decreases in the District's average Clear Creek releases over time, including changes in the actions necessary for the District to meet the consumptive demands of its customers;
- At least since 1998, the District's releases into Clear Creek have been made primarily to meet consumptive demands on the Clear Creek Segment of the Crawford Ditch, downstream of ID 97, rather than to meet its ID 97 obligations;
- Particularly in summer and fall, the District has not consistently maintained any minimum flow in the reach of Clear Creek downstream of the ditch diversion and upstream of the Cosumnes River, by allowing Clear Creek flows to bypass its diversion facilities on the Clear Creek Segment of the Crawford Ditch;
- The existing facilities to control the District's releases to Clear Creek are susceptible to substantial, uncontrollable fluctuations in flow, most notably during periods of high system demands;
- For many years, the District has assessed ID 97 property owners \$2.00 per parcel per year, and in recent years El Dorado County has added a \$0.30 per parcel processing fee for this assessment;

- The District is required to pay the United States Bureau of Reclamation a Habitat Restoration Fee for all water released into Clear Creek, although releases into Sly Park Creek for instream flows are exempt from this requirement;

and;

WHEREAS, the ID 97 property owners appointed representatives that met, exchanged information, and negotiated with District staff on numerous occasions between January 26 and September 8, 2004; and

WHEREAS, District staff recommended certain actions to the District's Board of Directors on September 8, 2004, the ID 97 representatives supported the recommendations of District staff, and District's Board of Directors ordered that the actions be taken, with some modifications;

NOW, THEREFORE, consistent with the September 8, 2004 orders of the District's Board of Directors, the parties hereby agree as follows:

1. That this Interim Agreement shall modify the terms and conditions of ID 97, as currently expressed in Resolution No. 74-147 and the ID 97 Feasibility Report, for so long as this Interim Agreement is in effect. As a modification of ID 97 and Resolution No. 74-147, which are by law binding upon all present and future ID 97 property owners and the District, this Interim Agreement shall likewise be binding upon all present and future ID 97 property owners, whether or not they are signators to this Interim Agreement, and upon the District, for so long as the Interim Agreement is in effect.
2. Except as otherwise provided in paragraph 10 below, the District shall make such releases into Clear Creek as are necessary to meet the parties' mutual intent to maintain a continuous target minimum flow of 3 cfs at the existing staff gage installed immediately upstream of the intersection of Clear Creek and the Sly Park Road bridge crossing.
3. Except as otherwise provided in paragraph 10 below, the District shall install, operate, and maintain physical modifications to the diversion facilities for the Clear Creek Segment of the Crawford Ditch sufficient to maintain a minimum flow of 0.5 cfs in Clear Creek immediately downstream of those diversion facilities.
4. All parties to this Interim Agreement will support and cooperate with the District in obtaining all needed easements or other property rights sufficient to access, operate, and maintain the staff gage identified in paragraph 2 above and the physical modifications identified in paragraph 3 above.
5. As soon as feasible, the District shall complete and publicly publish a rating table for the staff gage identified in paragraph 2 above. The District shall read

and log the staff gage at least once weekly, noting the date, time, and result of the readings, expressed both in terms of gage height and flow. The data obtained from this measuring device shall be public information and made available to the public upon request. In addition, the District shall post the data regularly on the District website.

6. In its sole discretion, the District may install, operate, and maintain physical modifications to the facilities it uses to release water into Clear Creek, in order to reduce fluctuations and increase the control over the amount and rate of water released. The District shall maintain a measuring device capable of recording the releases. The data obtained from this measuring device shall be public information and made available to the public upon request.
7. The District shall seek, and all parties to this Interim Agreement shall support and cooperate with the District in seeking, a waiver of all or some of the Habitat Restoration Fees otherwise owing to the United States Bureau of Reclamation as a result of the District's release of water pursuant to this Interim Agreement. To the extent that the District obtains any waiver of Habitat Restoration Fees, the District shall offset that waiver as a credit against its costs when computing ID 97 annual assessments.
8. The District shall not seek to increase ID 97 annual assessments to more than \$2.00 per parcel, plus County charge, without first complying fully with Articles 13C and 13D of the California Constitution (Proposition 218).
9. It is unlawful for any ID 97 property owner, or any other person, to divert or make any use of any water released by the District pursuant to ID 97 and this Interim Agreement, except for non-consumptive aesthetic purposes, or for use as a District customer in full compliance with District Rules and Regulations. The parties to this Interim Agreement have a mutual interest in preventing the unauthorized use of water released by the District. Therefore, if at any time the District is releasing 4 cfs into Clear Creek, but flow measured at the staff gage identified in paragraph 2 above is less than 3 cfs, the District shall not be obliged to increase its releases until it completes an investigation and abatement of any unauthorized uses, or sixty (60) days, whichever comes first. All parties to this Interim Agreement will support and cooperate with the District in conducting its investigation and abatement of any unauthorized uses.
10. The parties agree that in times of water shortage for the District's consumptive customers, a reasonable balance must be struck between the needs of ID 97 and the needs of the District's consumptive water customers. To accommodate these rare and unforeseeable occurrences, the parties agree that the obligations of paragraphs 2 and 3 above may be modified by reference to the District's "4-Stage Water Supply Matrix and Water Shortage Response Measures" ("Drought Response Plan") as adopted by the District Board of

Directors for the District-wide management of drought conditions or water shortages. A copy of the present Drought Response Plan is attached as Exhibit A. Under the present Drought Response Plan, the obligations of paragraphs 2 and 3 above may be modified as follows:

- a. When a "Stage 2 – Water Warning" is declared, the District shall not be obliged to release more than 2 cfs into Clear Creek.
- b. When a "Stage 3 – Water Emergency" is declared, the District shall not be obliged to release more than 1.5 cfs into Clear Creek.
- c. When a "Stage 4 – Critical Water Emergency" is declared, the District shall not be obliged to release more than 1 cfs into Clear Creek.
- d. Provided, however, that before the District invokes this Item 10, it will provide 30 days' written notice to all ID 97 property owners as listed on the then-current equalized County assessment roll, and schedule the matter for the approval or ratification of its Board at the first available regular Board meeting.

Further, the parties agree that at such time, if any, as the Drought Response Plan is replaced by a successor document adopted by the District Board of Directors, the parties shall meet and confer to consider amending this paragraph 10. The objective of any such amendment would be to modify the obligations of paragraphs 2 and 3 above by reference to the successor document, in a way that does not increase the amount and frequency of diminutions to Clear Creek flows authorized by this paragraph 10.

11. The District may, in its sole discretion, modify releases no more than once annually, and no longer than is necessary, for the sole purposes of: a) calibrating the rating curve for the existing staff gage installed immediately upstream of the intersection of Clear Creek and the Sly Park Road bridge crossing; b) to maintain, modify, or replace the facilities used for making releases; and/or c) obtaining data regarding base flow conditions in Clear Creek. The District shall provide advance notice of its intended actions to any ID 97 property owner who has submitted a written request for such notice. The District shall limit its modification of releases pursuant to this paragraph so that total flow at the staff gage does not fall below 1.0 cfs, and it shall plan the timing of any activities under this paragraph to attempt to eliminate or minimize adverse effects on aquatic species
12. This Interim Agreement represents the entire agreement between the parties. Except as modified by this Interim Agreement, ID 97 and Resolution No. 74-147 remain in full force and effect.

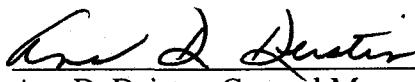
13. In accordance with the ID 97 Feasibility Report and applicable law, this Interim Agreement shall be construed as a petition to modify ID 97 pursuant to Water Code sections 23865 and 23879. As such, it shall not be effective until signed by two-thirds of the property owners presently included within ID 97, as listed in the current equalized County assessment roll, and approved by the District's Board of Directors at a subsequent noticed public hearing.
14. This Interim Agreement cannot be modified except in a writing signed by two-thirds of the property owners then included within ID 97, as listed in the then-current equalized County assessment roll, and approved by the District's Board of Directors at a subsequent noticed public hearing. Provided, however, that the dissolution of ID 97 in accordance with Water Code sections 24100, 24101, 24102, and 24103 (but expressly excluding section 24102.5), as each may be amended from time to time, shall terminate this Interim Agreement.
15. This Interim Agreement is legally binding upon all parties and each party reserves all legal, equitable, administrative, and regulatory remedies to enforce or construe it.
16. This Interim Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument. This Interim Agreement may also be executed by facsimile signature, in which event the facsimile signature shall constitute an original signature for purposes of enforcing this Interim Agreement.

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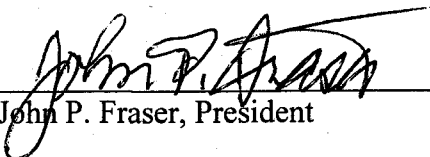
ID 97 Property Owners:

See attached master list and original signatures

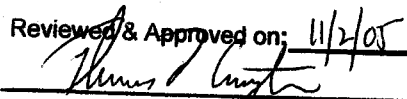
El Dorado Irrigation District:


Ane D. Deister, General Manager

Date: 11/3/05


John P. Fraser, President

Date: 12/1/05

Reviewed & Approved on: 11/2/05

EID General Counsel's Office
as to form

APPENDIX L

Drought Advisory Committee Comments on Drought Plan Strategy – October 29, 2007 Workshop

**Drought Advisory Committee
Comments on Drought Plan Strategy
October 29, 2007 Workshop**

1. Consider taking PL 101-514 contract water rights at an upstream location during declared Drought (Stage 2). Similar to the benefits of SMUD contracted rights of 15,000AF are less benefit if taken at Folsom Lake that requires pumping up hill to the extent possible.
2. Seek water rights and storage for 17,000AF of local sources of water (not just M&I water rights, but also water for agricultural use)
3. Revisit the agreements for Caples Lake storage for use in Drought Stage 2&3 (this is cheapest water available), The agreement has no dry year provision in the agreement and it is recommended to make dry-year conditions trigger the ability of maintaining lower storage levels for additional water supply.
4. Look to expand the uses of non-potable uses as the recycled water treatment systems expand (e.g. construction water, dust control). Currently, the recycled water system is maximized and requires make-up water to meet treatment and pressure system demands.
5. Need added flexibility to enhance system delivery reliability (e.g. water rights, dry year options)
6. Investigate the feasibility of using tunnels and mines to move or store water (outline the requirements for emergency transfers, i.e. Hazel Creek Tunnel from Project 184 Forebay to Sly Park Reservoir)
7. Incorporate into the Drought Plans for triggers from Governor Emergency declaration that would include communications, emergency transfers, interconnections, United States Bureau of Reclamation emergency funding (e.g., floating pumps to reach Folsom Lake levels for the El Dorado Hills Water Treatment Plant intake) and other response measures as appropriate.
8. Coordinate with Cosumnes American Bear Yuba (CABY) Planning Committee discussions to move more water to Folsom Lake (i.e. NID surplus water that could offset flow requirements from GDPUD and/or EID into Folsom Lake)
9. Follow-up on research in the CABY study on how to use meadow storage, restoration and recharge areas that were identified to investigate feasibility of added storage at higher elevations.
9. **NEED ADDITIONAL STORAGE** (both surface & groundwater) to offset the reduced snowpack natural storage that feeds our existing storage. Given scientists

- currently project that more and more supplies will be from precipitation than snowpack and will need to be carried over from year to year, water providers need to better equilibrate rainfall and snowpack melt runoff conditions through more storage capability.
10. Need enhanced interagency coordination including day to day support now and then heightened frequency in dry-years (e.g. new Grizzly Flats reservoir on USFS land swap with El Dorado Irrigation District opportunity)
 11. Need to promote drought and fire resistant plantings (e.g. immediate in coordinate with Fire Safe Council along with the new 100 ft clearance mandate)
 12. Need to incorporate more demand for fires flows, and need more recycled water seasonal storage (i.e. quarries) and also exchange recycled water to Folsom for potable water rights.
 13. Need to capitalize on conservation potential with grants funding that leads to action, get proposals ready for emergency grant funding.
 14. Need fixes for supply infrastructure with County assistance (e.g., facilitation and contract negotiations).
 15. Coordinate with California Department of Water Resources, who plans to hold small system workshops (e.g., support for GFCSD) and investigate funding assistance for more water supply reliability.
 16. Consider cloud seeding
 17. Enhance web sites and other notifications on actual customer water use in real time (e.g., self reading for water meters like the Badger remote data loggers that go on refrigerators such that customers can have a better self-assessment of their usage (AMR components now block ability to self-read meters).
 18. Have signage on total monthly (or weekly) water use by neighborhood and remote reading to help customers have feedback on how they are doing.
 19. Modify water shortage response actions by greatest water savings. Group by water use type vs. customer category.
 20. Put into place interruptible supply contracts (e.g., parks have reduced rates for less reliability)
 21. Create a mechanism that allows for higher allocations for those that already conserve (e.g., track accounts that have taken a rebate or performed a Water Wise House Call) and given them preferred allocations or lesser surcharges so they are not penalized for taking early action.

22. RESERVE FUND – establish an adequate funding reserve to sustain district operations in times of drought with the options for employing surcharges to trigger demand reductions and help with fiscal solvency in times of demand curtailment.
23. Estimate hidden costs of the drought like higher cost of services (e.g. water quality, energy use, manpower) that occur in times of demand shortfall to ensure that financial reserves and surcharge revenues will be adequate to meet needs.

