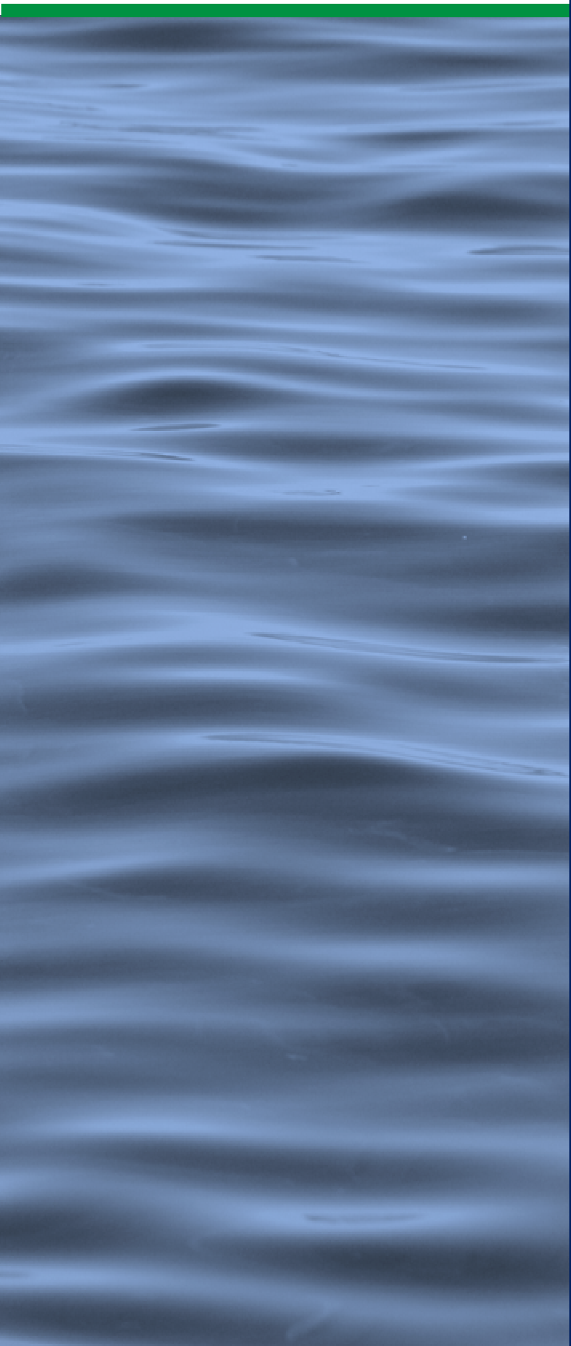
OAKDALE IRRIGATION DISTRICT



AGRICULTURAL WATER MANAGEMENT PLAN

DECEMBER 2012

prepared by

DAVIDS ENGINEERING, INC
www.de-water.com

Preface

This Agricultural Water Management Plan (AWMP or Plan) has been prepared by Oakdale Irrigation District (OID or District) in accordance with the requirements of the Water Conservation Act of 2009 (SBx7-7). SBx7-7 modifies Division 6 of the California Water Code (CWC or Code), adding Part 2.55 (commencing with §10608) and replacing Part 2.8 (commencing with §10800). In particular, SBx7-7 requires all agricultural water suppliers to prepare and adopt an AWMP as set forth in the CWC and the California Code of Regulations (CCR) on or before December 31, 2012. The Plan must be updated by December 31, 2015 and then every 5 years thereafter (§10820 (a)). Additionally, the CWC requires suppliers to implement certain efficient water management practices (EWMPs).

To develop and adopt this Plan by the December 31, 2012 deadline, the District initiated preparations in the fall of 2011, developed a project schedule and engaged technical consultants to assist with preparing the Plan. Working backwards from the December 31 deadline, the District scheduled a hearing to review the Plan and adoption by the Board of Directors at its first meeting in December (December 4, 2012). This was the latest schedule possible that would allow time to revise the Plan, if needed, in response to public comments. To allow a minimum of 14 days for public review of the Plan prior to the public hearing and adoption of the revised Plan in December, if necessary, the final draft of the Plan had to be complete by mid-November. To ensure the draft final Plan was complete by mid-November, all Plan sections were drafted by the beginning of October. In contrast to this schedule, the DWR Guidebook to Assist Agricultural Water Suppliers to Prepare a 2012 Agricultural Water Management Plan (Guidebook) was not released until November 5, 2012. Thus, the Guidebook was not available as a reference for preparation of this 2012 Plan. The main resources used to develop this 2012 Plan were the CWC itself, the relevant sections of the CCR, and the January 12, 2012 version of the Guidebook. The final Guidebook is anticipated to be referenced during preparation of the 2015 Plan.

Cross-Reference of Relevant Sections of the California Water Code to Oakdale Irrigation District 2012 Agricultural Water Management Plan

California Water Code, Division 6, Part 2.55. Sustainable Water Use and Demand Reduction

Chapter 4. Agricultural Water Suppliers				
Division	Subdivision	Paragraph	Code Language	Applicable AWMP Section(s)
10608.48	(a)		On or before July 31, 2012, an agricultural water supplier shall implement efficient water management practices pursuant to subdivisions (b) and (c).	**7**
	(b)		Agricultural water suppliers shall implement all of the following critical efficient management practices:	(see below)
		(1)	Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of Section 531.10 and to implement paragraph (2)	**3.7, 7, Att. B**
		(2)	Adopt a pricing structure for water customers based at least in part on quantity delivered.	**3.8, 7, Att. C**
	(c)		Agricultural water suppliers shall implement additional efficient management practices, including, but not limited to, practices to accomplish all of the following, if the measures are locally cost effective and technically feasible:	(see below)
		(1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	**7**
		(2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.	**4.4, 7**
		(3)	Facilitate the financing of capital improvements for on-farm irrigation systems.	**7**
		(4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at the farm level. (B) Conjunctive use of groundwater. (C) Appropriate increase of groundwater recharge. (D) Reduction in problem drainage. (E) Improved management of environmental resources. (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	**3.8, 7, Att. C**
		(5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance, and reduce seepage.	**1.3.1, 3.3, 7, 8**
		(6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits.	**1.3.1, 3.3, 7, 8**
		(7)	Construct and operate supplier spill and tailwater recovery systems.	**1.3.1, 3.3, 7, 8**
		(8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area.	**1.3.1, 7, 8**
		(9)	Automate canal control structures.	**1.3.1, 3.3, 7, 8**
		(10)	Facilitate or promote customer pump testing and evaluation.	**7**
		(11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress reports.	**7**
		(12)	Provide for the availability of water management services to water users. These services may include, but are not limited to, all of the following: (A) On-farm irrigation and drainage system evaluations. (B) Normal year and real-time irrigation scheduling and crop evapotranspiration information. (C) Surface water, groundwater, and drainage water quantity and quality data. (D) Agricultural water management educational programs and materials for farmers, staff, and the public.	**7**
		(13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	**7**
		(14)	Evaluate and improve the efficiencies of the supplier’s pumps.	**1.3.1, 4.3, 7, 8**

Division	Subdivision	Paragraph	Code Language	Applicable AWMP Section(s)
10608.48	(d)		Agricultural water suppliers shall include in the agricultural water management plans required pursuant to Part 2.8 (commencing with Section 10800) a report on which efficient water management practices have been implemented and are planned to be implemented, an estimate of the water use efficiency improvements that have occurred since the last report, and an estimate of the water use efficiency improvements estimated to occur five and 10 years in the future. If an agricultural water supplier determines that an efficient water management practice is not locally cost effective or technically feasible, the supplier shall submit information documenting that determination.	**7, 8**

California Water Code, Division 6, Part 2.8. Agricultural Water Management Planning

Chapter 3. Agricultural Water Management Plans				
Article 1. General Provisions				
Division	Subdivision	Paragraph	Code Language	Applicable AWMP Section(s)
10820	(a)		An agricultural water supplier shall prepare and adopt an agricultural water management plan in the manner set forth in this chapter on or before December 31, 2012, and shall update that plan on December 31, 2015, and on or before December 31 every five years thereafter.	**2**
10821	(a)		An agricultural water supplier required to prepare a plan pursuant to this part shall notify each city or county within which the supplier provides water supplies that the agricultural water supplier will be preparing the plan or reviewing the plan and considering amendments or changes to the plan. The agricultural water supplier may consult with, and obtain comments from, each city or county that receives notice pursuant to this subdivision.	**2**
	(b)		The amendments to, or changes in, the plan shall be adopted and submitted in the manner set forth in Article 3 (commencing with Section 10840).	**2**
Article 2. Contents of Plans				
Division	Subdivision	Paragraph	Code Language	Applicable AWMP Section(s)
10826			An agricultural water management plan shall be adopted in accordance with this chapter. The plan shall do all of the following:	(see below)
	(a)		Describe the agricultural water supplier and the service area, including all of the following:	(see below)
		(1)	Size of the service area.	**3**
		(2)	Location of the service area and its water management facilities.	**3**
		(3)	Terrain and soils.	**3**
		(4)	Climate.	**3**
		(5)	Operating rules and regulations.	**3, Att. A**
		(6)	Water delivery measurements or calculations.	**3, Att. B**
		(7)	Water rate schedules and billing.	**3, Att. C**
		(8)	Water shortage allocation policies.	**3, Att. D**
10826	(b)		Describe the quantity and quality of water resources of the agricultural water supplier, including all of the following:	(see below)
		(1)	Surface water supply.	**4, 5**
		(2)	Groundwater supply.	**4, 5**
		(3)	Other water supplies.	**4, 5**
		(4)	Source water quality monitoring practices.	**4**
		(5)	Water uses within the agricultural water supplier's service area, including all of the following: (A) Agricultural. (B) Environmental. (C) Recreational. (D) Municipal and industrial. (E) Groundwater recharge. (F) Transfers and exchanges. (G) Other water uses.	**5**
		(6)	Drainage from the water supplier's service area.	**5**

Division	Subdivision	Paragraph	Code Language	Applicable AWMP Section(s)
10826	(b)	(7)	Water accounting, including all of the following: (A) Quantifying the water supplier's water supplies. (B) Tabulating water uses. (C) Overall water budget.	**5, Att. G**
		(8)	Water supply reliability.	**4, 5**
	(c)		Include an analysis, based on available information, of the effect of climate change on future water supplies.	**6**
	(d)		Describe previous water management activities.	**1.3, 7, 8**
	(e)		Include in the plan the water use efficiency information required pursuant to Section 10608.48.	**All**
			Article 3. Adoption and Implementation of Plans	
Division	Subdivision	Paragraph	Code Language	Applicable AWMP Section(s)
10841			Prior to adopting a plan, the agricultural water supplier shall make the proposed plan available for public inspection, and shall hold a public hearing on the plan. Prior to the hearing, notice of the time and place of hearing shall be published within the jurisdiction of the publicly owned agricultural water supplier pursuant to Section 6066 of the Government Code. A privately owned agricultural water supplier shall provide an equivalent notice within its service area and shall provide a reasonably equivalent opportunity that would otherwise be afforded through a public hearing process for interested parties to provide input on the plan. After the hearing, the plan shall be adopted as prepared or as modified during or after the hearing.	**2**
10842			An agricultural water supplier shall implement the plan adopted pursuant to this chapter in accordance with the schedule set forth in its plan, as determined by the governing body of the agricultural water supplier.	**1.3.1, 7, 8**
10843	(a)		An agricultural water supplier shall submit to the entities identified in subdivision (b) a copy of its plan no later than 30 days after the adoption of the plan. Copies of amendments or changes to the plans shall be submitted to the entities identified in subdivision (b) within 30 days after the adoption of the amendments or changes.	**2**
	(b)		An agricultural water supplier shall submit a copy of its plan and amendments or changes to the plan to each of the following entities:	(see below)
		(1)	The department.	**2**
		(2)	Any city, county, or city and county within which the agricultural water supplier provides water supplies.	**2**
		(3)	Any groundwater management entity within which jurisdiction the agricultural water supplier extracts or provides water supplies.	**2**
		(4)	Any urban water supplier within which jurisdiction the agricultural water supplier provides water supplies.	**2**
		(5)	Any city or county library within which jurisdiction the agricultural water supplier provides water supplies.	**2**
		(6)	The California State Library.	**2**
		(7)	Any local agency formation commission serving a county within which the agricultural water supplier provides water supplies.	**2**
10844	(a)		Not later than 30 days after the date of adopting its plan, the agricultural water supplier shall make the plan available for public review on the agricultural water supplier's Internet Web site.	**2**
	(b)		An agricultural water supplier that does not have an Internet Web site shall submit to the department, not later than 30 days after the date of adopting its plan, a copy of the adopted plan in an electronic format. The department shall make the plan available for public review on the department's Internet Web site.	**2**

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Attachments

Acronyms and Abbreviations

AB3616	Assembly Bill 3616, the Agricultural Efficient Water Management Act of 1990
af	Acre-Feet
af/ac	Acre-Feet per Acre
af/ac-yr	Acre-Feet per Acre per Year
AWMC	Agricultural Water Management Council
AWMP	Agricultural Water Management Plan
BMO	Basin Management Objective
BO	Biological Opinion
CASGEM	California Statewide Groundwater Elevation Monitoring System
CCR	California Code of Regulations
CCUF	Crop Consumptive Use Fraction
CDEC	California Data Exchange Center
CDM	Camp Dresser McKee
cfs	Cubic Feet per Second
CHO	Constant Head Orifice
CIMIS	California Irrigation Management Information System
CIP	Cast In Place
CNRA	California Natural Resources Agency
CSJWCD	Central San Joaquin Water Conservation District
CVP	Central Valley Project
CWC	California Water Code
DF	Delivery Fraction
DMS	Database Management System
DSO	Distribution System Operator
DSS	Decision Support System
DWR	California Department of Water Resources
EIR	Environmental Impact Report
ESJWQC	East San Joaquin Water Quality Coalition
ET	Evapotranspiration
ETa	Actual Evapotranspiration
ETaw	Crop Evapotranspiration of Applied Water
ETo	Reference Evapotranspiration
ETpr	Crop Evapotranspiration of Precipitation
EWMP	Efficient Water Management Practice
FWUA	Friant Water Users Authority
GMP	Groundwater Monitoring Plan
gpm	Gallons per Minute
IDC	Integrated Water Flow Model (IWFM) Demand Calculator
in	Inches
IRGMP	Integrated Regional Groundwater Management Plan
mph	Miles per Hour
MID	Modesto Irrigation District
MOU	Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California
NASS	National Agricultural Statistics Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System

NRCS	Natural Resources Conservation Service
OID	Oakdale Irrigation District
PEIR	Programmatic Environmental Impact Report
PG&E	Pacific Gas and Electric
PVC	Polyvinyl Chloride
RWQCB	Regional Water Quality Control Board
SBx7-7	Senate Bill x7-7, Water Conservation Bill of 2009
SCADA	Supervisory Control and Data Acquisition
SEBAL	Surface Energy Balance Algorithm for Land
SEWD	Stockton East Water District
SJCDWQC	San Joaquin County and Delta Water Quality Coalition
SOI	Sphere of Influence
SSJID	South San Joaquin Irrigation District
STRGBA	Stanislaus and Tuolumne Rivers Groundwater Basin Association
SWRCB	(California) State Water Resources Control Board
TAF	Thousands of Acre-Feet
TCC	Total Channel Control
TID	Turlock Irrigation District
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
VAMP	Vernalis Adaptive Management Plan
VFD	Variable Frequency Drive
WMF	Water Management Fraction
WRP	Water Resources Plan
WUE	Water Use Efficiency

Executive Summary

Introduction

Oakdale Irrigation District (OID or District) has prepared this Agricultural Water Management Plan (AWMP) in accordance with the requirements of the Water Conservation Act of 2009 (SBx7-7). This AWMP updates the District's 2005 AWMP and describes OID's leadership in water management within its sphere of influence and the San Joaquin Valley as a whole. The District's mission is to protect and develop OID water resources for the maximum benefit of the Oakdale Irrigation District community by providing excellent irrigation and domestic water service. Recent water management activities by the District include development of the OID Water Resources Plan (WRP), a comprehensive study of the District's water resources, delivery system, and operations. The overall objective of the WRP is to identify how the District can best protect its water rights while developing affordable methods of financing the necessary improvements to continue to meet the needs of all its stakeholders and serve the region.

Development of the AWMP represents a substantial effort by OID to evaluate its progress in implementing the WRP and overall water management, including the development of detailed water balances spanning the period from 2005 to 2011 for the distribution system, the farmed lands, and the drainage system of OID and its customers. Additionally, OID has evaluated the implementation of the full range of efficient water management practices (EWMPs) detailed in SBx7-7 with respect to its water management objectives and various water use efficiency improvements.

Water Resources Plan

The OID distribution system infrastructure and operating policies evolved primarily to satisfy the needs of forage crops, and are still generally adequate to meet those needs. However, improved water delivery strategies were needed to satisfy the evolving irrigation needs of orchards and other specialty crops. The OID Board and management recognized that modernization of the District's policies, procedures and facilities was needed. As a result, and in conjunction with increased financial capability resulting from completion of payments on a large bond issue leading to increased revenue from hydropower generation, and increases in revenue from water transfers, the District undertook the development of the comprehensive OID WRP. The overall objective of the WRP was to identify how the District could best protect its water rights while developing affordable methods of financing the necessary improvements to continue to meet the needs of all its stakeholders and serve the region. The WRP includes an evaluation of financial objectives and needs, annexation of adjacent lands, water transfers, and other considerations.

Since completion of a Programmatic Environmental Impact Report (PEIR) for the WRP in 2007, OID has actively implemented improvements identified in the WRP. Improvements under the WRP include canal maintenance and rehabilitation, flow control and measurement, groundwater well replacement, pipe replacement, regulating reservoir construction, a Woodward Reservoir intertie (since deferred), turnout maintenance and replacement, outflow management projects (i.e. spillage and runoff reduction and reuse), reclamation projects, SCADA system expansion, and annexation. Additionally, critical main canal and tunnel improvement projects have been and are currently being implemented to reduce the risk of critical failures that could leave the District unable to deliver water to large portions of its service area. Implementation of the WRP has occurred largely according to schedule and in some cases ahead of schedule.

The estimated cost of infrastructure improvements to be implemented under the WRP is in excess of $170 million (2007 dollars). These improvements will continue to be implemented over the 25 year planning horizon and fall in the following general categories:

- Main Canals and Tunnels Improvement Projects ($45 million)
- Canal and Lateral Rehabilitation ($34 million)
- Flow Control and Measurement Structures ($4 million)
- New and Replacement Groundwater Wells ($14 million)
- Pipeline Replacement ($45 million)
- North Side Regulating Reservoir ($6 million)
- Irrigation Service Turnout Replacement ($5 million)
- Outflow Management Projects ($11 million)
- Reclamation Projects ($6 million)
- Miscellaneous In-System Improvements ($2 million)

Critical infrastructure and water conservation improvements being implemented under the WRP are being funded through regional water transfers primarily via a pay as you go approach; as water is conserved and transferred, OID receives revenue and implements additional improvements, resulting in additional water conservation. In 2009, OID pushed forward with WRP implementation by bonding for $32 million to provide funding for critical infrastructure and large scale water conservation projects to be substantially completed by 2012.

The scope of the WRP encompasses the topics addressed in this AWMP, including evaluation of individual EWMPs. As a result, the EWMPs that OID is implementing are integral to a well-planned, comprehensive distribution system modernization program. This AWMP describes past, current, and future OID actions and initiatives related to each EWMP, in the context of the WRP and other water management actions by OID.

Implementation of Efficient Water Management Practices

SBx7-7 describes sixteen EWMPs aimed at promoting efficient water management. Of these, two are “critical” or mandatory and the remaining fourteen are to be implemented if technically feasible and locally cost effective. Of the fourteen conditional EWMPs, OID is implementing all of those that are technically feasible at locally cost effective levels and continues to increase implementation of key EWMPs that most effectively support the District’s water management objectives and align with the WRP. The EWMPs, along with past and future implementation activities by OID are described in Table ES-1.

Conclusion

Development of this AWMP has provided OID with an opportunity to evaluate and describe its ongoing agricultural water management practices with a focus on implementation of OID's comprehensive WRP. The AWMP includes an evaluation of how these actions support the Agency's local water management objectives as well as past and future water use efficiency improvements. As demonstrated in the AWMP, OID is a local leader in water management and is committed to the ongoing evaluation and implementation of water management practices that meet local objectives. In the future, OID will continue to increase efforts to effectively manage available water supplies.

Table ES-1. Summary of OID Implementation Status for EWMPs Listed Under SB7x-7

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
Critical (Mandatory) Efficient Water Management Practices				
10608.48.b(1)	Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of Section 531.10 and to implement paragraph (2).	Being Implemented	1. Evaluated and categorized all turnouts with respect to measurability. 2. Developed standards for using USBR meter gates and constant head orifice (CHO) meter gates where applicable and other types of new standardized turnout measurement devices where not applicable. 3. Dedicated annual budget line item for turnout replacement and initiated replacement of turnouts requiring corrective actions. 4. Development and implementation of a Water Measurement Plan for customer deliveries (Attachment B).	1. Continue to dedicate annual budget line item for turnout replacement 2. Continue replacement of turnouts requiring corrective actions. 3. Continue implementation of Water Measurement Plan (Attachment B).
10608.48.b(2)	Adopt a pricing structure for water customers based at least in part on quantity delivered.	Being Implemented	1. Volumetric billing for out-of-district water sales and future annexations. 2. Development and implementation of a plan to develop volumetric pricing (Attachment D).	1. Continue volumetric billing for out-of-district water sales and annexed lands. 2. Continue implementation of plan to develop volumetric pricing (Attachment D).
Additional (Conditional) Efficient Water Management Practices				
10608.48.c(1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Lands with exceptionally high water duties or whose irrigation contributes to significant problems are not found within the District boundaries, nor within the District Sphere of Influence. Furthermore, OID's rules and regulations prohibit wasteful use of water, preventing exceptional water duties or significant problems from occurring.	
10608.48.c(2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils	Being Implemented	1. Sconza Candy cooling water to the district distribution system. 2. Tomato processing water is applied directly to lands within the District.	1. Continue existing use of recycled water within OID. 2. Consider requests from all qualifying permitted dischargers for additional use of recycled water.
10608.48.c(3)	Facilitate financing of capital improvements for on-farm irrigation systems	Being Implemented	1. Technical assistance to growers implementing on-farm improvements through the NRCS EQIP program.	1. Continue technical assistance to growers implementing on-farm improvements through the NRCS EQIP program.
10608.48.c(4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented	1. OID promotes conjunctive use of groundwater by setting water rates to promote surface water use (when available) over groundwater use. 2. Volumetric pricing and additional efficiency requirements apply for the receipt of out-of-district water.	1. Continue to promote use of surface water supplies 2. Include incentive pricing structure in new volumetric pricing policy.

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
10608.48.c(5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage	Being Implemented	1. Concrete lined approximately 3.3 miles of South Main Canal and tunnels in 2010 2. Concrete lined 105 miles of canals 3. Replaced 100 miles of canals with buried pipeline 4. Constructed Robert Van Lier Reservoir in 2001 5. Constructed the North Side Regulating Reservoir in 2010	1. Implement WRP main canal and tunnels improvement projects. 2. Implement WRP canal and lateral rehabilitation projects. 3. Implement WRP pipeline replacement projects.
10608.48.c(6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits	Being Implemented	1. Planned and initiated transition, within facility constraints, to an arranged demand ordering and delivery schedule for orchard and corn irrigators who require increased delivery flexibility. Under arranged demand, growers are typically provided water within 72 hours of placing their order with OID.	1. Continue transition to arranged demand ordering and delivery schedule for orchard and corn irrigators who require increased delivery flexibility. Under arranged demand, growers are typically provided water within 72 hours of placing their order with OID. As facility constraints are eased by facility modernization program, service constraints will also ease. 2. Implement WRP flow control and measurement structures projects 3. Implement WRP turnout replacement projects
10608.48.c(7)	Construct and operate supplier spill and tailwater recovery systems	Being Implemented	1. Two drainwater recovery systems irrigate more than 760 acres. OID plans to develop a drainwater collection system on the south side of the Stanislaus River. 2. Reclamation pumping within OID to recover approximately 9,300 af annually 3. Interception and reuse of approximately 2,100 af per year of tailwater entering the OID distribution system 4. Gravity flow and lift pumping of approximately 22,100 af per year to the neighboring districts of MID, SSJID, and CSJWCD 5. Automation of the District's laterals to provide downstream control has the potential to dramatically reduce spillage through spillage prevention	1. Continue discussions with potential customers outside of the District's Sphere of influence for developing a drainwater collection system. 2. Implement WRP outflow management projects. 3. Implement WRP reclamation projects.
10608.48.c(8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	Being Implemented	1. Established incentive pricing structure supporting conjunctive use. 2. Improving flexibility in water ordering and delivery to encourage use of surface water and discourage surface users from converting to groundwater. 3. Participated in regional Groundwater Management Plan Development. 4. Participating in regional development of Groundwater Model 5. Identified potential groundwater recharge areas for protection. 6. Enhancing groundwater production capability.	1. Utilize regional groundwater model as a planning tool to develop optimized conjunctive use strategies to: (1) enhance groundwater production and uniformity of availability of GW supplies, (2) work with growers who have wells to encourage use of groundwater during surface water shortages, and (3) consider annexation and transfers to provide in lieu recharge (including adjacent groundwater users). 2. Continue improving flexibility in water ordering and delivery to encourage use of surface water and discourage surface users from converting to groundwater. 3. Implement WRP groundwater well, reclamation, and outflow management projects.

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
10608.48.c(9)	Automate canal control structures	Being Implemented	1. Automated inlets and outlets to the regulating reservoirs 2. Automated Cashman Dam and Little John Creek Diversion Dam 3. Automated 30 canal and pipeline headings 4. Installed 31 automated flow control gates and six automated turnouts 5. Installed 28 automated checks as part of a pilot TCC program on the Claribel and Cometa laterals.	1. Continue to automate the remaining canal and pipeline headings. 2. Complete pilot test of TCC and evaluate. 3. Implement WRP flow control and measurement structure projects.
10608.48.c(10)	Facilitate or promote customer pump testing and evaluation	Being Implemented	1. Promotes use of the PG&E pump testing program by private pumpers within the District. 2. Link to PG&E Ag Pump Efficiency Program on OID web site. 3. As part of STRGBA, evaluated groundwater pumping efficiencies for irrigation and domestic supply and completed a well-field optimization study.	1. Continue to promote use of the PG&E pump testing program by private pumpers within the District.
10608.48.c(11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented	1. Designated a Water Conservation Coordinator in October 1997.	1. Continue to employ a designated Water Conservation Coordinator.
10608.48.c(12)	Provide for the availability of water management services to water users.	Being Implemented	1. Link to CIMIS on OID web site. 2. Links to cooperative extension and other agricultural information on OID web site. 3. Newsletter provided to customers. 4. Promotion of mobile labs. 5. Offer no-cost on-farm irrigation consulatations and review by OID staff upon request and as associated circumstances arise.	1. Link to CIMIS on OID web site. 2. Links to cooperative extension and other agricultural information on OID web site. 3. Newsletter provided to customers. 4. Promotion of mobile labs. 5.
10608.48.c(13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented	1. Continuing discussions with Reclamation to obtain a Warren Act Contract with the USBR to gain carryover storage in New Melones Reservoir to provide greater dry year flexibility. 2. Identify mechanisms for voluntary transfers of water that facilitate greater water supply flexibility and storage. 3. Active participation in initiatives that affect its water users.	1. Continuing discussions with Reclamation to obtain a Warren Act Contract with the USBR to gain carryover storage in New Melones Reservoir to provide greater dry year flexibility. 2. Identify mechanisms for voluntary transfers of water that facilitate greater water supply flexibility and storage. 3. Continue to actively participate in initiatives that affect its water users.
10608.48.c(14)	Evaluate and improve the efficiencies of the supplier's pumps.	Being Implemented	1. Annual testing and evaluation of 64 pumps within OID boundaries by qualified staff. 2. As part of STRGBA, evaluated groundwater pumping efficiencies for irrigation and domestic supply and completed a well-field optimization study. 3. Annual maintenance and improvements as part of WRP implementation.	1. Continue testing and evaluation program for existing pumps. 2. Continue to include new wells and pumps in the existing program to evaluate and improve pump efficiencies.

1. Introduction

The Oakdale Irrigation District (OID or District) 2012 Agricultural Water Management Plan (AWMP or Plan) describes water use and water management activities within OID. A primary function of the AWMP is to document the ongoing implementation of OID's Water Resources Plan (WRP) prepared in November 2005 (CH2MHill 2005). This AWMP has been prepared in accordance with the requirements of the Water Conservation Bill of 2009 (SBx7-7), which modifies Division 6 of the California Water Code (CWC), adding Part 2.55 (commencing with §10608) and replacing Part 2.8 (commencing with §10800).

This AWMP updates OID's previous AWMP adopted by the Board of Directors in September 2005. The 2005 AWMP was prepared according to the Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California (MOU). The MOU was developed by the advisory committee for Assembly Bill 3616, the Agricultural Efficient Water Management Act of 1990 (AB3616). The MOU established the Agricultural Water Management Council (AWMC). As a signatory of the MOU, OID is a member of the AWMC.

This section provides a brief description of OID's history and evolution, discussion of the implementation of OID's comprehensive WRP, an overview of the requirements of SBx7-7, and the implications of these factors to the development of this Plan.

1.1 OID History

OID was formed in 1909 and in 1910 purchased certain Stanislaus River water rights and facilities from two existing water companies. Half interest in this acquisition was deeded to OID's sister district, the South San Joaquin Irrigation District (SSJID). Thereafter, the Districts initiated expansion of their shared storage and respective distribution systems. OID and SSJID hold pre-1914 water rights for diversion of 1,816.6 cfs from the Stanislaus River at Goodwin Dam. Construction of New Melones Reservoir (completed in 1979) resulted in potential impacts on the ability of the districts to divert water under their senior water rights. In 1988 OID and SSJID entered into an operational agreement with USBR recognizing and protecting the rights of the districts. This agreement dictates the obligations and responsibilities of the USBR in the delivery of the district's water rights through the New Melones facility. The agreement provides the districts a combined supply of 600,000 acre-feet (af) of water annually, subject to availability, representing one of the most abundant and reliable water supplies in California (Figure 1-1).

Figure 1-1. New Melones Dam

Despite a secure and abundant water supply, OID's financial constraints forced it to operate primarily in the mode of controlling costs to match limited available revenues for several decades. Consequently, OID's operation and maintenance practices did not change substantially for more than 50 years. Meanwhile, regional and State water demands grew, customer needs within the District began to change, and many components of the conveyance system began to reach the end of their service lives.

Throughout the long history of irrigation in Oakdale, forage crops grown to support the substantial dairy and livestock operations in the region have dominated the irrigated cropping pattern. Although permanent crops, particularly almonds, have expanded within OID in recent years, forage crops[1] continue to account for about 70% of the irrigated land in the District. The OID distribution system infrastructure and operating policies evolved primarily to satisfy the needs of forage crops, and are still generally adequate to meet those needs. However, improved water delivery strategies were needed to satisfy the evolving irrigation needs of orchards and other specialty crops.

The OID Board and management recognized that modernization of the District's policies, procedures and facilities was needed. As a result, and in conjunction with increased financial capability resulting from completion of payments on a large bond issue leading to increased revenue from hydropower generation, and increases in revenue from water transfers, the District undertook the development of the comprehensive OID Water Resources Plan (Figure 1-2). The WRP identifies specific actions best suited to meet its modernization goals. Since completion of a Programmatic Environmental Impact Report (PEIR) in 2007, OID has actively implemented many of the specific improvements identified in the WRP.

Improved water delivery infrastructure and operational practices are being designed and implemented to satisfy the irrigation needs of all OID water users, including orchards and other specialty crops. In particular, water control and storage within the distribution system are being increased through extensive physical and operational improvements, reducing system losses and enabling improvement of delivery practices including low-volume deliveries on more flexible, high-frequency schedules, while continuing to allow traditional high-volume deliveries on low-frequency schedules.

Figure 1-2. OID Water Resources Plan

1.2 Requirements of SBx7-7 and the California Water Code

The Water Conservation Bill of 2009 (SBx7-7 or Bill) amends the California Water Code (CWC) Division 6 with regards to agricultural and urban water management by adding Part 2.55 (commencing with §10608) and replacing Part 2.8

[1] Includes pasture and double-cropped oats and corn.

(commencing with §10800). In particular, SBx7-7 requires all agricultural water suppliers to prepare and adopt an AWMP as set forth in the Bill on or before December 31, 2012. The plan must be updated by December 31, 2015 and then every five years thereafter (§10820 (a)).

Additionally, the Bill requires agricultural water suppliers to implement certain efficient water management practices (EWMPs). Specifically, under §10608.48 of the CWC, all agricultural water suppliers are required to implement the following "critical" EWMPs:

(1) Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of §531.10.
(2) Adopt a pricing structure for water customers based at least in part on quantity delivered.

Further, agricultural water suppliers are required to implement the following EWMPs, if they are locally cost effective and technically feasible:

(1) Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.
(2) Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.
(3) Facilitate financing of capital improvements for on-farm irrigation systems.
(4) Implement an incentive pricing structure that promotes one or more of the following goals:
    (A) More efficient water use at the farm level.
    (B) Conjunctive use of groundwater.
    (C) Appropriate increase of groundwater recharge.
    (D) Reduction in problem drainage.
    (E) Improved management of environmental resources.
    (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.
(5) Expand or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance, and reduce spillage.
(6) Increase flexibility in water ordering by, and delivery to, water customers within operational limits.
(7) Construct and operate supplier spill and tailwater recovery systems.
(8) Increase planned conjunctive use of surface water and groundwater within the supplier service area.
(9) Automate canal structures.
(10) Facilitate or promote customer pump testing and evaluation.
(11) Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress reports.
(12) Provide for the availability of water management services to water users. These services may include, but are not limited to, all of the following:
    (A) On-farm irrigation and drainage system evaluations.

(B) Normal year and real-time irrigation scheduling and crop evapotranspiration information.
(C) Surface water, groundwater, and drainage water quantity and quality data.
(D) Agricultural water management educational programs and materials for farmers, staff, and the public.

(13) Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.
(14) Evaluate and improve the efficiencies of the supplier's pumps.

Agricultural water suppliers not in compliance with the Bill are not eligible for state water grants or loans.

1.3 Previous Water Management Activities

1.3.1 2005 Water Resources Plan

OID's mission is to protect and develop Oakdale Irrigation District water resources for the maximum benefit of the Oakdale Irrigation District community by providing excellent irrigation and domestic water service. In order to achieve this mission today and in the future, the District's Board of Directors initiated the development of the OID Water Resources Plan (WRP) in November of 2004. The WRP is a comprehensive study of the District's water resources, delivery system, and operations. The overall objective of the WRP was to identify how the District could best protect its water rights while developing affordable methods of financing the necessary system improvements to continue to meet the needs of all its stakeholders and serve the region. The WRP includes an evaluation of financial objectives and needs, annexation of adjacent lands, water transfers, and other considerations. The Draft Plan was completed in November 2005 and finalized following the completion of a draft Programmatic Environmental Impact Report (PEIR) in January 2007. The specific goals of the WRP are depicted in Figure 1-3.

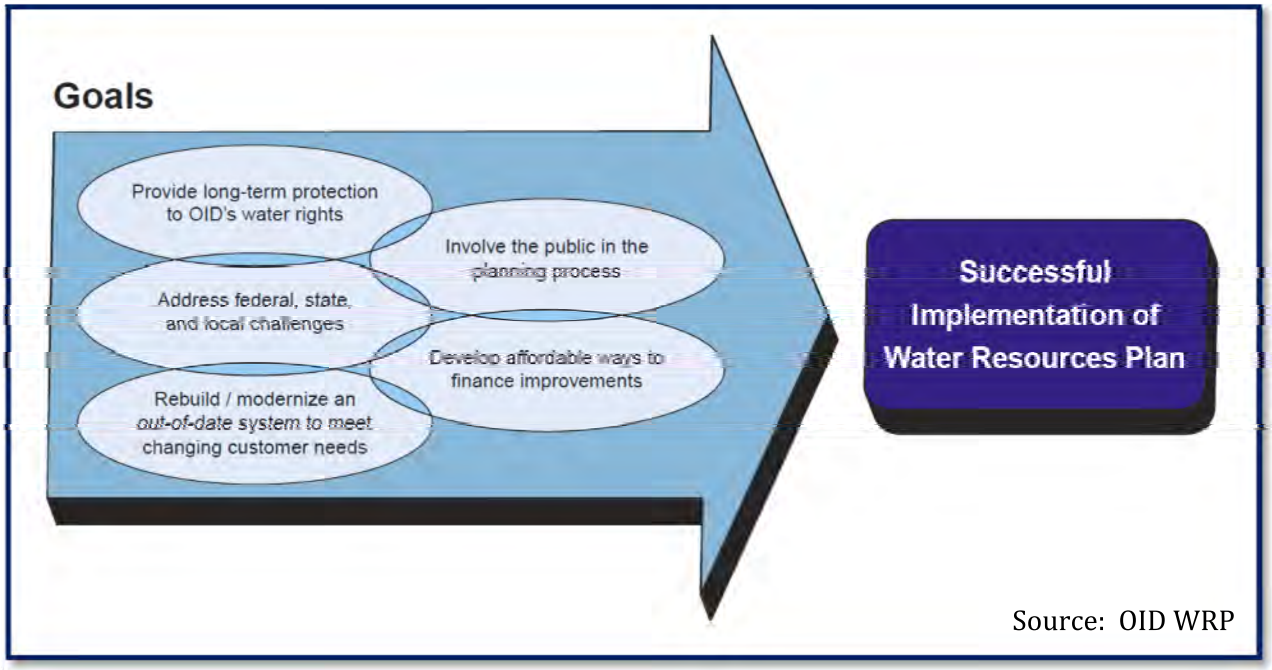

Figure 1-3. Goals of the OID Water Resources Plan

Development of the WRP included comprehensive analysis of OID's Stanislaus River water rights, current and future groundwater levels, irrigation practices, and the OID delivery system. The analysis also included review of historical land use trends and development of forecasted future land use trends and related impacts on water supplies, demands, and operational requirements to meet water user needs. The WRP provides specific, prioritized recommendations for OID physical and operational improvements as well as a plan to phase the implementation of improvements consistent with available financial resources. The WRP implementation schedule is shown in Figure 1-4.

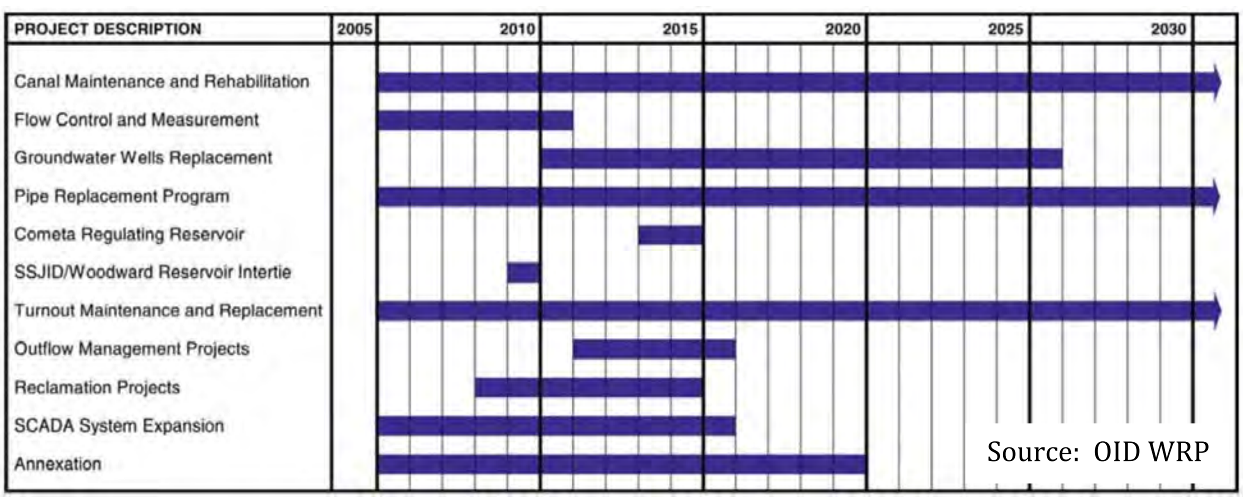

Figure 1-4. OID WRP Implementation Schedule

As indicated by the schedule, improvements under the WRP include canal maintenance and rehabilitation, flow control and measurement, groundwater well replacement, pipe replacement, regulating reservoir construction, a Woodward Reservoir intertie (since deferred), turnout maintenance and replacement, outflow management projects (i.e. spillage and runoff reduction and reuse), reclamation projects, SCADA system expansion, and annexation. Additionally, critical main canal and tunnel improvement projects have been and are currently being implemented to reduce the risk of critical failures that could leave the District unable to deliver water to large portions of its service area. Implementation of the WRP has occurred largely according to schedule and in some cases ahead of schedule.

The estimated cost of infrastructure improvements to be implemented under the WRP is in excess of $170 million (2007 dollars). These improvements will continue to be implemented over the 25 year planning horizon and fall in the following general categories:

- Main Canals and Tunnels Improvement Projects ($45 million)
- Canal and Lateral Rehabilitation ($34 million)
- Flow Control and Measurement Structures ($4 million)
- New and Replacement Groundwater Wells ($14 million)
- Pipeline Replacement ($45 million)
- North Side Regulating Reservoir ($6 million)
- Irrigation Service Turnout Replacement ($5 million)
- Outflow Management Projects ($11 million)
- Reclamation Projects ($6 million)
- Miscellaneous In-System Improvements ($2 million)

Critical infrastructure and water conservation improvements being implemented under the WRP are being funded through regional water transfers primarily via a pay as you go approach; as water is conserved and transferred, OID receives revenue and implements additional improvements, resulting in additional water conservation. In 2009, OID pushed forward with WRP implementation by bonding for $32 million to provide funding for critical infrastructure and large scale water conservation projects to be completed by 2012. The bonds will be repaid with water transfer revenues.

The scope of the WRP encompasses the topics addressed in this AWMP, including evaluation of individual EWMPs. As a result, the EWMPs that OID is implementing are integral to a well-planned, comprehensive distribution system modernization program. This AWMP describes past, current, and future OID actions and initiatives related to each EWMP, which are largely guided by the WRP.

1.3.2 Other Water Management Activities

The District is involved in a variety of other water management activities at local, regional, and state levels. These activities include the following:

- **2005 Agricutural Water Management Plan.** OID previously prepared an AWMP that was adopted by the District's Board of Directors in September 2005. The 2005 AWMP was prepared according to the MOU developed by the advisory committee for AB3616, which established the AWMC. As a signatory of the MOU, OID is a member of the AWMC.
- **Stanislaus and Tuolumne Rivers Groundwater Basin Association (www.strgba.org).** OID has developed an SB1938-compliant Integrated Regional Groundwater Management Plan (IRGMP) for the Modesto Groundwater Subbasin as part of a coalition of local agencies and cities (Bookman-Edmonston 2005). The purposes of the association are to evaluate groundwater supply; promote coordinated groundwater management planning; develop a hydrologic groundwater model of the subbasin; determine the need for additional or improved extraction, storage, delivery, conservation, and recharge facilities; and to provide information to guide the management, preservation, protection, and enhancement of groundwater quality and quantity in the subbasin. The goal of the IRGMP is to conjunctively manage water supplies to ensure a reliable, long-term water supply to meet beneficial uses by agricultural, industrial, and municipal users while protecting the environment. The District adopted the plan by resolution on August 2nd, 2005.
- **East San Joaquin Water Quality Coalition (www.esjcoalition.org).** The District is a member of the East San Joaquin Water Quality Coalition under the Irrigated Lands Regulatory Program of the State Water Resources Control Board, which represents the portion of OID in Stanislaus County. The coalition was formed in 2003 to represent dischargers who own or operate irrigated lands east of the San Joaquin River within Madera, Merced, Stanislaus, Tuolumne and Mariposa Counties and portions of Calaveras County. The coalition files required reports with the Central Valley Regional Water Quality Control Board, conducts a water quality monitoring program for area rivers and agricultural drains, and works with land owners to solve water quality problems, if they are found. Prior to joining the coalition in 2011, OID filed as an individual discharger and collected its own water quality information from 2004 to 2010.
- **San Joaquin County and Delta Water Quality Coalition (www.sjdeltawatershed.org).** The District is a member of the Delta Water Quality Coalition under the Irrigated Lands Regulatory Program of the State Water Resources Control Board, which represents the portion of OID in San Joaquin County. The coalition was formed in 2003 to represent dischargers who own or operate irrigated lands in portions of San Joaquin County, Calaveras County, and Contra Costa County. The coalition files required reports with the Central Valley Regional Water Quality Control Board, conducts a water quality monitoring program for area rivers and agricultural drains, and works with land owners to solve water quality problems, if they are found. Prior to joining the coalition in 2011, OID filed as an individual discharger and collected its own water quality information from 2004 to 2010.
- **Tri-Dam Project and Power Authority (www.tridamproject.com).** The Tri-Dam Project and the Tri-Dam Power Authority are partnerships between OID and SSJID that developed and now operate and maintain two reservoirs above New Melones Lake and one reservoir below the Lake on the Stanislaus River. The reservoirs are operated for irrigation water supply and power generation, as well as for recreation and associated wateractivities.

- **Save the Stan (www.savethestan.com).** Save the Stan is a public education program of SSJID and OID. The purpose of the program is to inform the public about the NOAA Biological Opinion (BO) for the protection of Central Valley steelhead from the operations of New Melones Reservoir and the associated ramifications on the local ecosystem, economy and water supply. In particular, the district is concerned that the BO reasonable and prudent alternatives would result in an empty New Melones Reservoir in approximately one of six years.
- **San Joaquin Tributaries Authority (calsmartwater.org).** The SJTA mission is to promote sound, environmentally responsible solutions to water supply management within a framework that recognizes the historic rights of its member agencies and the concerns of its ratepayers.

2. Plan Preparation

2.1 AWMP as Water Resources Plan "Report Card"

As described previously, this AWMP has been prepared in accordance with SBx7-7 and the CWC. More fundamentally, this plan provides an update describing the status of WRP implementation and lays out ongoing and future water management actions by the District.

2.2 Public Participation

Public participation in the development of this Plan included:

- Notification of OID's intent to update its AWMP was made via letters to required agencies and a notice in the Modesto Bee on November 19 and November 26, 2012;
- Posting of the draft Plan on the District's web page on November 19, 2012;
- Review of the publicly noticed presentation of the draft Plan at a special hearing on December 4, 2012; and
- Approval of the final Agricultural Water Management Plan at a regularly scheduled Board of Directors meeting on December 18, 2012.

The public is invited to attend all Board meetings with time reserved on each agenda for public comment. The Board members are accessible to the public by phone and at Board meetings. The District has a web site where the agendas of all Board meetings are published along with the most recent Board minutes, newsletters and other important information. Comments can also be received via e-mail using a link on the OID website (www.oakdaleirrigation.com).

The District distributes a newsletter periodically to publicize important local, state and federal issues impacting its constituents. The District maintains an open exchange of information with local newspapers and, if necessary, issues press releases on matters of importance to the public.

The District also relies to a certain extent on employees in the field to keep customers informed of the latest water management information.

2.3 Regional Coordination

The District coordinates operation of the Tri-Dam Project cooperatively with SSJID and coordinates with neighboring districts and other entities as appropriate; however, OID does not plan to develop a regional AWMP at this time due to differences in the institutional, physical, and operational characteristics of each District.

3. Background and Description of Service Area

3.1 History and Organization

OID was organized in 1909 under the California Irrigation District Act, which provided for the organization of irrigation districts and for the acquisition or construction thereby of works for irrigation of lands embraced within such district and also to provide for distribution of water for irrigation purposes, approved March 31, 1897, (Statutes 1897, p. 254 et seq.).

On September 13, 1909, a petition was presented to the Stanislaus County Board of Supervisors by the Board of Directors of the Oakdale Irrigation District signed by a majority of the holders of title of lands within the proposed District. The petition requested permission to organize an irrigation district under the California Irrigation District Act. The Board of Supervisors ordered that an election be held on October 23, 1909. Formation of the District was approved by more than two thirds of the voters within the proposed District boundaries.

After the task of legal formation was complete, the Board of Directors adopted a plan for constructing the necessary canals and works and acquiring the necessary property and rights to carry out the provisions of the act under which it was created. The Board determined that $1,600,000 would be required to carry out this plan. Since the District was newly formed, bonds were necessary to raise the capital, and on February 26, 1910, another election was held to seek constituent approval for issuance of bonds. In the interim, another election was held to raise $30,000 to make repairs and to pay salaries of employees.

A more detailed description of the history of the development of the District's surface water supply is provided in Section 4: Inventory of Water Supplies.

The District is organized into five political divisions with each division being represented by a director who is elected for a four-year term by the landowners residing within the division. Elections are held every two years so that only two or three of the directors' seats are subject to election at any one time. The Board of Directors elects a Board President to run the meetings and a Vice-President to serve if the Board President is unavailable. The Board President serves for a two-year term. Directors of OID also serve as board members on the Tri-Dam Authority Board and the Tri-Dam Project Board of Directors together with Directors from the SSJID.

The General Manager is principal administrative officer of the District and serves as Secretary to the Board of Directors. The Chief Financial Officer/Treasurer, the Contracts and Special Projects Manager, the District Engineer, the Water Operations Manager, and the Support Services Manager report to the General Manager. Currently, there are 69 full-time District employees with four employees in Administration, five employees in Accounting, four employees in Engineering, two employees in Contracts Management, 31 employees in Water Operations, and 23 employees in

Operations and Maintenance (Support Services)[2]. An organizational chart of the District is provided in Figure 3-1.

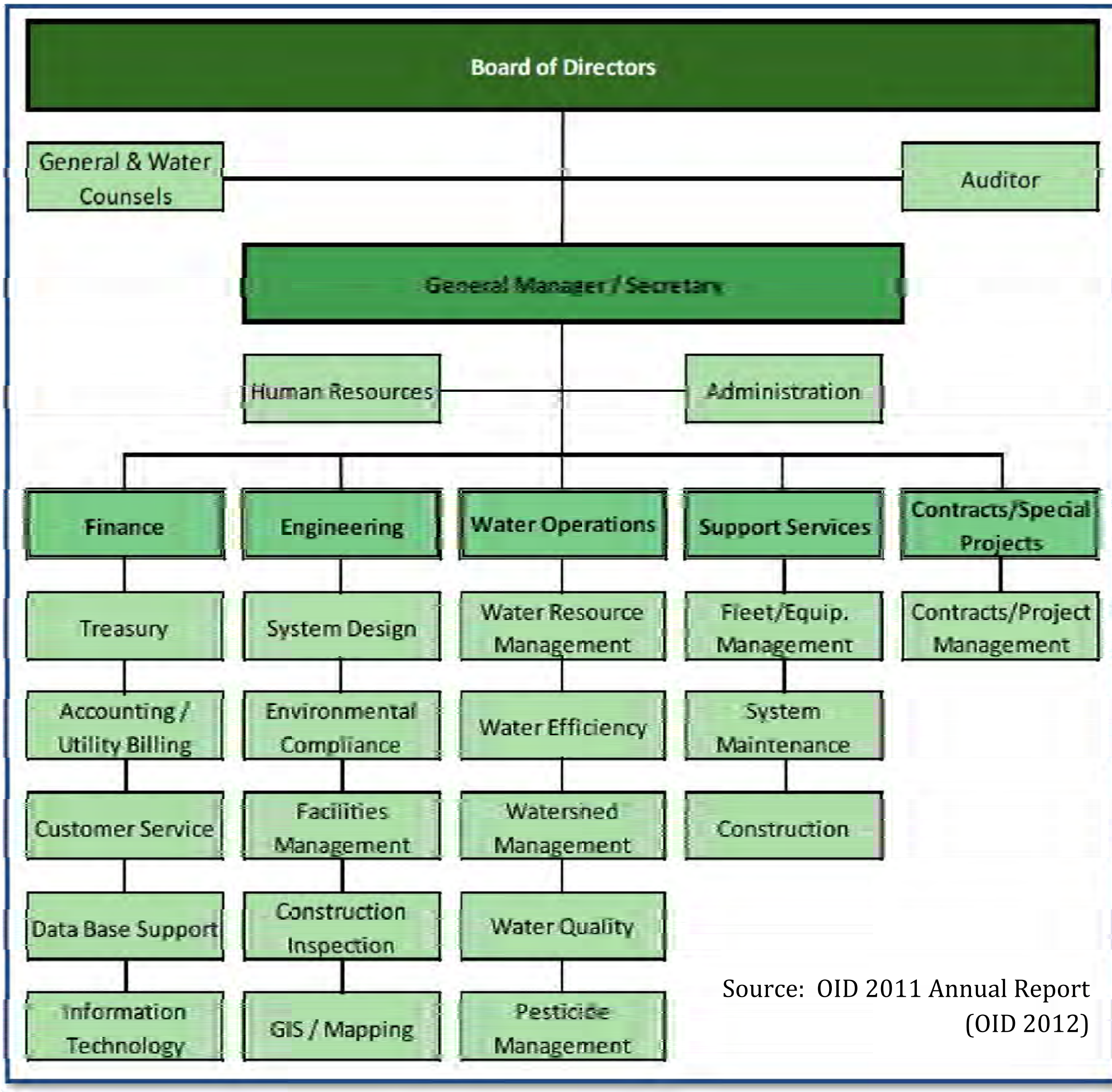

Figure 3-1. OID Organizational Chart

3.2 Size and Location of Service Area

The District is located in the northeastern portion of the San Joaquin Valley, approximately thirty miles southeast of Stockton and twelve miles northeast of Modesto (Figure 3-2). The District encompasses lands located both north and south of the Stanislaus River, with about 20% of these

[2] Number of employees from 2011 OID Annual Report.

lands located within southeastern San Joaquin County and 80% in eastern Stanislaus County. OID is bounded by the Modesto Irrigation District (MID) to the south and west, by the SSJID to the west, and by the Central San Joaquin Water Conservation District (CSJWCD) to the north.

Upon formation, the District included the towns of Oakdale, Riverbank and Valley Home (then called Thalheim). Riverbank detached from the District in 1981, although some small "islands" of the town remain in the District.

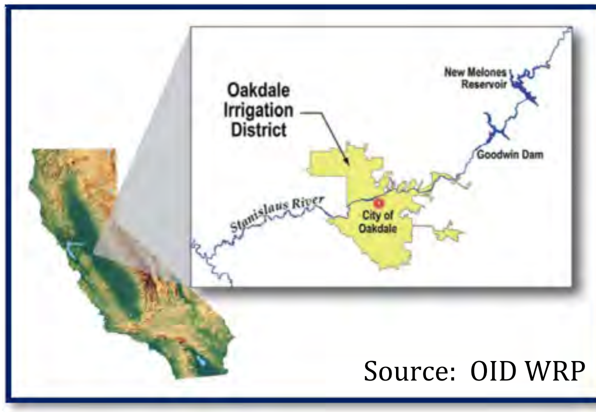

Figure 3-2. Location of OID

The District's current service area encompasses approximately 74,600 acres, of which 55,256 acres were assessed an irrigation charge in 2011.

3.3 OID Distribution System

OID diverts water from the Stanislaus River at Goodwin Dam into the Joint Main Canal on the north side of the River and the South Main Canal on the south side. The Joint Main Diversion (OID North Main Canal and SSJID Main Canal headings) is operated by the Tri-Dam Project. OID schedules orders for the Frymire Lateral with the Tri-Dam Project but controls the headgate remotely. Approximately 3.5 miles downstream of Goodwin Dam, the Joint Main Canal bifurcates into OID's North Main Canal (Figure 3-3) and SSJID's Main Canal. The North Main Canal and Frymire Lateral serve approximately 23,608 acres, or 43% of OID's total irrigated area.

The South Main Canal serves the remaining 31,648 acres, or 57%, of OID's irrigated area. The South Main breaks out of the Stanislaus River canyon roughly a mile upstream of the Community of Knight's Ferry, runs due south for about two miles, and approximately ten miles southwesterly, terminating near the heads of four major OID lateral headings: the South, Brichetto, Claribel and Riverbank Laterals. The Joint Main, North Main and South Main Canals have a combined length of 35 miles. The District constructed the 250 acre-foot Robert Van Lier Regulating Reservoir in 2001 near the terminus of the South Main Canal, which enhances the delivery flexibility to growers while also allowing for reduction of operational spillage. In early 2010, the District completed construction of the 300 acre-foot

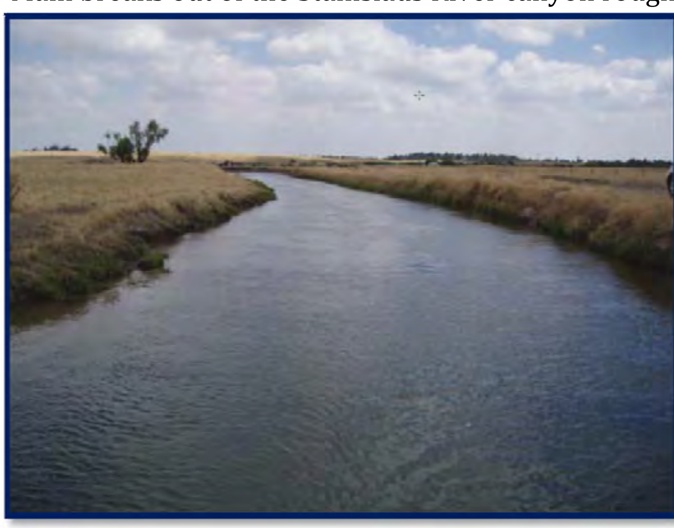

Figure 3-3. North Main Canal

North Side Regulating Reservoir, which provides similar benefits to the north side of the District (Figure 3-4).

Water is delivered to landowners through approximately 2,000 delivery gates served by approximately 330 miles of laterals off of the main canals. Originally, the entire lateral system consisted of open, unlined ditches. Over time, selected laterals and lateral reaches have either been concrete lined or placed in low-head, cast-in-place (CIP) concrete or PVC pipelines. In the 1980s, the District received a $22 million low-interest loan under the Bureau of Reclamation PL-984 Loan Program, which was used to construct fifty miles of CIP pipelines and related standpipes and water control structures. At the present time, approximately 100 miles of the District's laterals are pipelines, 105 miles are open, concrete-lined ditches, and the remainder are unlined open ditches. However, the 105 miles of concrete lined ditches typically are not continuous, meaning that concrete lining occurs in short reaches along mostly unlined ditches. The condition of the lining is generally best in the main canals as compared to the laterals.

Figure 3-4. North Side Regulating Reservoir

The main and lateral distribution system remains upstream level controlled as originally constructed, with a few exceptions:

- Completion in 2001 of the Robert Van Lier Regulating Reservoir near the terminus of the South Main Canal and completion in 2010 of the North Side Regulating Reservoir near the terminus of the North Main Canal enables flow changes to be made more readily than before. The reservoirs are operated to increase delivery flexibility to water users while also reducing operational spillage by better matching diversion and delivery volumes. Additionally, the reservoirs provide for steadier flow to downstream laterals, improving the steadiness of farm deliveries and enabling on-farm water management improvements. Reservoir storage fluctuates daily with the objective of operating within the middle one third of the capacity.
- The Cometa and Claribel laterals were automated in 2011 as part of a pilot automation project and are currently being operated in downstream flow control. Similar automation may be extended to other laterals in the future, following the two-year pilot project.

The District maintains ninety miles of drains, along which are located 42 District drainwater (reclamation) pumping plants. These pumping plants recover drainwater and, in most cases, return it to the OID distribution system for supply to water users. In some cases the pumps are used to lift water into the adjacent Modesto Irrigation District (MID) distribution system. Finally, the District owns and operates 25 groundwater production wells, which are used primarily for operational convenience and to provide supplemental water supply.

A map of the District's water management facilities is provided in Figure 3-5 on the following page.

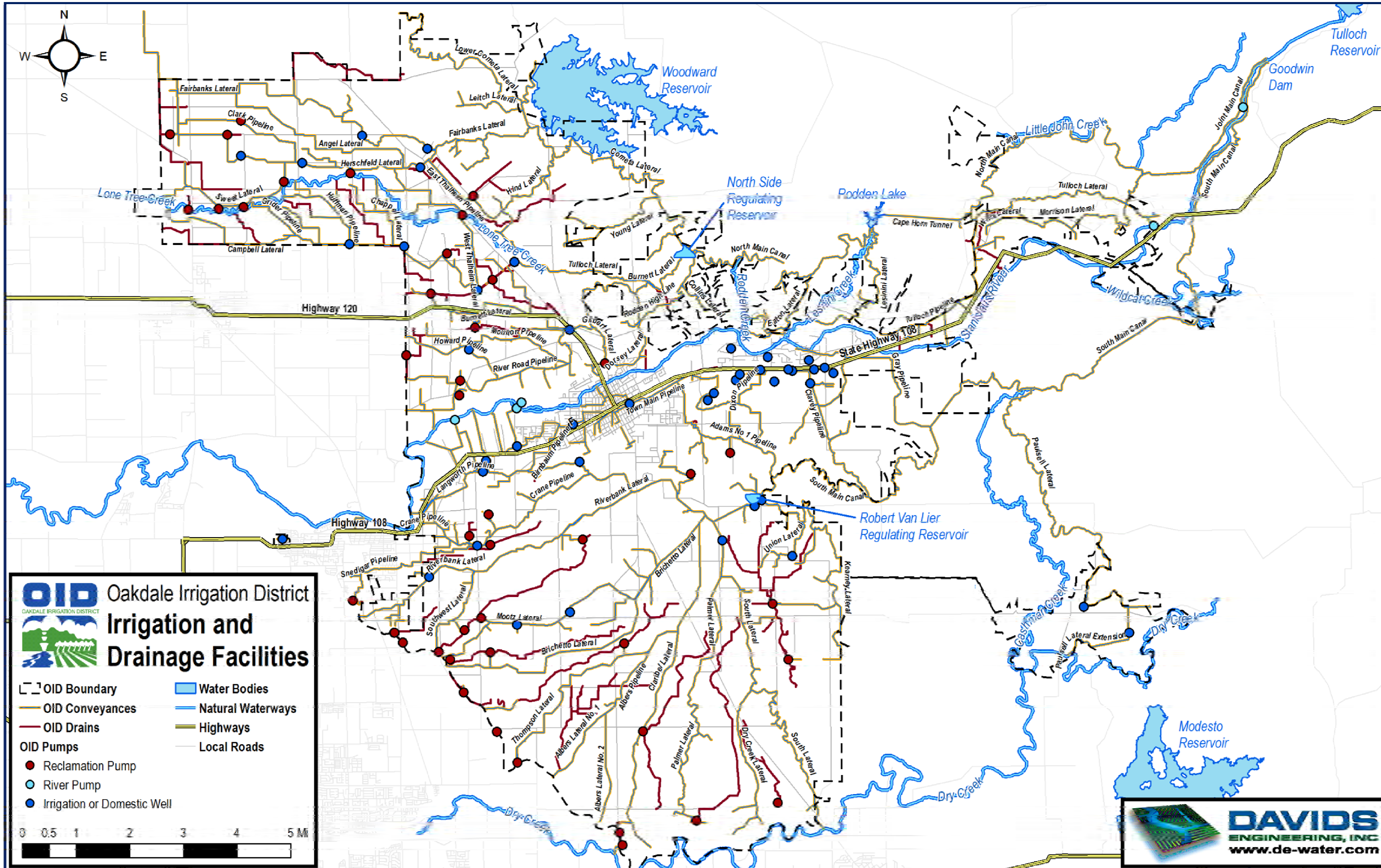

Figure 3-5. Oakdale Irrigation District Irrigation and Drainage Facilities

The District is currently divided into ten Distribution System Operator (DSO) divisions, including five north of the Stanislaus River and five south of the River. The divisions operate under the supervision of the Water Operations Manager. Within divisions, actual field operations are executed by the DSOs. OID has a total of 24 DSOs, including ten to cover the regular day shift, five for relief day shift, seven to cover the regular night shift and two for the relief night shift. DSOs work six days on, three-days off, twelve hours per shift. Tables 3-1a and 3-1b below show the number of irrigated acres and number of parcels by division, based on data from the 2010 irrigation season.

Table 3-1a. Number of Acres and Parcels by Division (South Side)

Statistic	Division 1	Division 2	Division 3	Division 4	Division 5
Irrigated Area (acres)	5,282	7,492	12,058	3,340	3,517
No. of Parcels	202	272	252	385	285*
Avg. Parcel Size (acres)	26	28	48	9	12

* Number of parcels does not include parcels within the city limits of Oakdale

Table 3-1b. Number of Acres and Parcels by Division (North Side)

Statistic	Division 6	Division 7	Division 8	Division 9	Division 10
Irrigated Area (acres)	3,059	4,718	4,757	3,402	8,122
No. of Parcels	283	409	365	225	189
Avg. Parcel Size (acres)	11	12	13	15	43

Division size ranges between 3,059 acres and 12,058 acres and averages 5,575 acres. The number of parcels ranges between 189 and 409 and averages 287 per division. The average parcel size ranges between nine and 48 acres, and averages about nineteen acres. The divisions have been delineated to achieve uniform division of workloads among DSOs. To the extent possible, divisions are organized so that DSOs have control of their water from the main canal heading to the tail of their respective laterals. There are cases, however, where water is passed through one division to the next, rather than being delivered directly from the North or South Main Canals. In these cases, the upstream DSO is required to provide a steady flow rate to the downstream DSO according to the daily operations plan.

OID has historically delivered water on a rotational basis. The season generally begins (typically in late March or early April) with a fourteen to sixteen day rotation frequency. The rotation frequency is typically incrementally increased to ten days as crop water use rates increase with ET during the peak of the summer, and then decreased incrementally back to fourteen or sixteen day as crop water use rates taper off in the late summer and fall.

Beginning in 1998, the District initiated an arranged demand scheduling system to better meet the needs of specialty crops (crops other than pasture) and associated high-frequency irrigation systems, such as drip and micro-spray. The goal is to deliver water to specialty crop customers as soon as possible within 72 hours (three days) of ordering. Delivery shutoff times are scheduled at the same time that the water order is placed; early shutoffs may be made arranged with one hour advance notification to the DSO. The District is able to provide this additional flexibility to growers subject to the capacity and operational constraints of the distribution system. As the number of specialty crop growers has increased, it has become increasingly difficult to provide the desired flexibility without system modernization. In response, OID has and continues to modernize its distribution system and update operational procedures to provide arranged demand scheduling to its specialty crop growers.

Historically, DSOs have used “rotation sheets” to organize and track water deliveries. One rotation sheet is prepared for each division, with the customers organized under each lateral on the sheet in the order in which they receive water. Important information about each customer is also provided on the sheet, including the customer’s name, address, phone number, irrigators name and phone number, crop type, assessor’s parcel number, irrigated acreage, number of hours to receive irrigation water, and delivery rate. As part of the modernization process being implemented under the WRP, OID is in the process of transitioning to digital entry of water orders using computers.

Each DSO is responsible for determining how much water his or her division will need on a daily basis and requesting that amount from the main canal tender. (Note: The Division 1 and Division 6 DSOs act as main canal tender for the North and South Main Canals respectively, in addition to operating their divisions.) The DSOs may cooperatively transfer water between divisions to manage their rotations, if water is available. For example, if one division is cutting 10 cfs and the adjoining division is adding 10 cfs, the water can be transferred between the two, thereby avoiding routing two flow changes along the main canal. Each day, the main canal tender totals the division requests, calculates the change from the current flow rate and submits a flow change request (increase or decrease) to the Water Operations Supervisors. The Water Operations Supervisor then requests the operator at the Tri-Dam Authority to make the scheduled change.

Flow changes are also sometimes needed within the operating day. When accommodations cannot be made by Tri-Dam to adjust the flow as requested, the Robert Van Lier Regulating Reservoir on the south side or the North Side Regulating Reservoir on the north side are used as a buffer to meet the excess downstream demands or store the extra water.

Each DSO has a cellular phone that is used to notify customers of when they will receive irrigation water and to whom to pass the water when their turn is complete. The cellular phones are transferred between the day shift and night shift DSOs so that customers have only one number to call per division, any time of the day or night. Customers typically call to request schedule changes, or to report unusual conditions, such as delivery interruption. SCADA alarms are also transmitted to DSOs via text messaging or automated recording.

In addition, an emergency phone is carried by the Water Operations Manager, a Water Operations Supervisor, or a roving DSO (DSO not assigned to a specific division who is available to assist wherever needed). During the non-irrigation season, the on-call supervisor carries the emergency phone.

3.4 Terrain and Soils

OID is located along the flanks of the San Joaquin Valley, between the foothills to the east and the nearly flat lands in the valley floor. The topography within the District varies from gently rolling to nearly level. Land surface elevation varies from nearly 300 feet on the east side near the Community of Knights Ferry to about 100 feet near Riverbank. The northern portions of the District west of Valley Home Road are nearly flat. East of Oakdale, the terrain is steeper while the topography on the south side of the District is moderately undulating, sloping in a southwesterly direction toward to the valley floor, with natural drains dissecting the terrain from northeast to southwest.

Soils within the District can generally be placed into two broad groups: those on the alluvial fans of the Stanislaus River and the soils out of the floodplain on fans and terraces. The alluvial soils tend to be deep and well to moderately well drained, making them suitable for all crops and particularly well suited for deep rooted tree crops such as walnuts and almonds. These soils are confined to the river corridor and therefore are limited in extent.

By comparison, the terrace soils occupy a much larger area, and are generally shallower and less well drained. In addition, major portions of the terrace soils are affected by hardpan conditions, which can severely restrict root development and penetration. The terrace soils are best suited for pasture and forage crops, although they can be modified by deep ripping to be made suitable for tree crops, particularly almonds. More and more of the terrace soils are being planted to tree crops over time.

3.5 Climate

The climate statistics presented in this section are based on the Oakdale CIMIS station (#194), established in 2004. In the District's previous AWMP, climate statistics were based on the Modesto CIMIS station (#71). Average weather parameters are similar between the two stations, but the Oakdale CIMIS station is considered more appropriate due to its closer proximity to the District, despite having less years of data available than the Modesto station.

OID has a climate typical of the San Joaquin Valley, with mild winters with moderate precipitation and warm, dry summers. Average daily maximum temperatures range from a low of about 55°F in December and January to a high of nearly 92°F in July (Table 3-2). Mean daily minimum temperatures range from a low of 36°F in December and January to a high of about 59°F in July. Average annual reference evapotranspiration (ETo) is approximately 54 inches, ranging from a low of one inch in December and January to a high of over eight inches in July. Approximately three quarters of the annual ETo occurs in the six-month period from April through September.

Average annual precipitation is 15.9 inches, with 12.8 inches, or slightly more than three quarters, occurring in the five month period from November through March.

Even during the peak summer period, the average maximum relative humidity reaches 78%, which is indicative of an irrigated area, and exceeds 90% between November and April. Minimum relative humidity ranges between approximately 30% during the summer and roughly 65% during the wet winter months.

Average wind speed is lowest in November (4.0 miles per hour) and highest in the summer (6.4 mph in June and July).

There are no significant microclimates within the District that affect water management or operations.

Table 3-2. Mean Daily Weather Parameters by Month at Oakdale CIMIS Station (December 2004 through April 2012)

Month	Total ETo (in)	Total Precip. (in)	Average Daily Temperature (F)			Average Relative Humidity (%)			Average Wind Speed (mph)
			Average	Min.	Max.	Average	Min.	Max.	
January	1.1	5.6	44.8	35.8	55.1	83.8	65.5	94.9	4.5
February	1.9	2.1	49.2	38.5	61.3	77.4	55.1	93.9	4.8
March	3.4	2.0	52.4	40.5	65.3	73.4	49.9	93.1	5.3
April	4.7	1.3	56.4	43.2	70.3	67.0	43.6	91.0	5.3
May	6.7	0.7	63.8	48.9	78.9	58.3	35.6	86.0	5.8
June	7.8	0.2	69.9	53.9	85.3	53.4	32.4	81.6	6.4
July	8.5	0.0	75.1	59.0	91.8	51.3	31.4	77.6	6.4
August	7.5	0.0	72.8	57.2	89.4	53.3	32.3	79.6	5.9
September	5.6	0.1	69.2	54.6	85.7	56.0	33.7	82.1	5.1
October	3.5	0.8	60.8	47.8	76.3	63.4	39.6	86.9	4.6
November	1.8	0.8	51.7	40.1	65.4	75.6	51.7	93.1	4.0
December	1.0	2.3	45.2	36.3	55.5	81.3	62.0	93.3	4.9
Annual	53.6	15.9	59.3	46.3	73.4	66.2	44.4	87.7	5.2

3.6 Operating Rules and Regulations

The District "Rules and Regulations Governing the Operation and Distribution of Irrigation Water within the Oakdale Irrigation District Service Area" (Rules and Regulations) are occasionally reviewed and revised as needed to address changing conditions, most recently in 2005. The rules and regulations prescribe conditions that ensure distribution of irrigation water to users in an orderly, efficient and equitable manner; they are available to water users and the public in pamphlet form or in electronic form from the OID website, and are attached to this report for convenient reference (Attachment A).

3.7 Water Delivery Measurement and Calculation

OID has initiated substantial changes to improve flow measurement as part of implementation of the WRP in order to improve delivery service to irrigation customers while also increasing institutional knowledge of system operations to support ongoing operations and maintenance as well as future planning. Additionally, OID has prepared a plan to comply with the Agricultural Water Measurement regulation included as §597 of Title 23 of the California Code of Regulations. The plan is included as part of this AWMP. See Section 7 and Attachment B (Water Measurement Plan) for more information.

Historically, the general approach to improving water measurement within OID was to focus efforts on the improved measurement of inflows and outflows at the District boundaries (where needed) and to progress inward with upstream to downstream priority, as financial resources became available. This approach enabled development of a District-wide water balance and increasingly allowed for the evaluation of water management within subdivisions of the District. As part of modernization of the distribution system underway as part of implementing the WRP, OID's focus has progressed to rehabilitation of all diversions from the main canals. Downstream flow measurement and control, coupled with upstream level control and flow measurement are instrumental to the OID modernization process.

Water diverted from the Stanislaus River into the Joint and South Main Canals is measured by gaging stations operated and maintained by the Tri-Dam Authority to U.S. Geological Survey standards. OID has engaged outside services to conduct monthly checks and to refine the ratings of these boundary inflow gages.

Figure 3-6. Cashman Dam

Releases from main canals into laterals are measured by various means, including rated pipeline gates, open channel flow measurement devices, and rated canal sections. Water stage is measured by various means including pressure transducers, ultrasonic water level sensors, weir sticks, measuring tapes, Clausen rules, and stilling wells with staff gauges. Prior to the start of each irrigation season, DSOs are provided training in water measurement devices and techniques. During the season, the DSOs measure and report the amount of water entering their divisions on a daily basis, or more frequently as needed.

The majority of farm deliveries are measured by rated gates (Constant Head Orifice or Meter-gate) or, in some cases, by determining the difference in flow between measurements points in the lateral upstream and downstream of the farm turnout. Records of water deliveries to farms are maintained on daily run sheets and are currently being transitioned to electronic entry to facilitate reporting of aggregate water deliveries.

System spillage and on-farm tailwater are collected by a system of private and District drains and are captured by OID for reuse or flow out of OID at numerous locations. Drainwater outflows contribute to water supplies for MID, SSJID, CSJWCD and private parties (see Section 5.6 for additional information regarding outflows and their recipients). OID undertook and completed a systematic evaluation and ranking of the boundary flow measurement sites in 2003 for the purpose of identifying the improvements needed at each site and prioritizing the sites to maximize cost effectiveness. Pursuant to the ranking of outflow sites, OID has established reliable flow measurement at seven operational spillage sites and nine drainage spill sites since that time. The monitored operational and drainage spill sites represent approximately 60% of the total boundary outflows from OID. The District plans to continue to increase the number of measured operational spills and boundary outflow sites over time.

As part of the preparation of this AWMP, a detailed analysis was conducted by OID operations staff to delineate drainage watersheds within the District. All drainage from a given area leaves the District at a single location. Additionally, some areas do not have any surface outflow. The area of each drainage watershed was used in conjunction with boundary outflow data to estimate the total boundary outflows from OID. Additionally, the analysis enables OID to better evaluate potential projects to reduce or recover boundary outflows for use within OID, effectively increasing the District's available surface water supply.

3.8 Water Rate Schedules and Billing

Historically, OID has billed for irrigation water deliveries to OID customers on a flat rate, per-acre basis. Rates and payment due dates are established annually by the Board of Directors. The per-acre rate varies depending on the size of the parcel. The rates for 2011 are provided in Table 3-3. Typically, water charges are billed annually in early November and may be paid in two installments usually due in December and June.

Table 3-3. OID Water Charges (per acre) for 2011

	Water Charge (per acre) by Parcel Size (in acres)						
Year	Min. per acre	1.01 - 2.00	2.01 - 4.00	4.01 - 6.00	6.01 - 8.00	8.01 - 10.00	10.01 & above
2011	$ 30.00	$ 30.00	$ 28.00	$ 26.00	$ 24.00	$ 22.00	$ 19.50

For additional information describing the existing rate structure, refer to Sections 4013 through 4017 of OID's Rules and Regulations, included in Attachment A.

Out-of-District Surface Irrigation Agreements are annual contracts for the delivery of OID surface water which must be approved by the BOD each year before the start of the irrigation season. Each year, OID makes a determination on the availability of any "surplus" surface irrigation water for Out-of-District Surface Irrigation Agreements. There is no guarantee that Out-of-District water will be available every year, and the water is provided at a premium rate as set annually by the BOD. The Out-of-District water rate is currently assessed either volumetrically (per acre-foot) if a District acceptable measuring device has been installed or at an equivalent fee per acre based on the applicable annual crop allocation. Several conditions must also be met prior to the receipt of Out-of-District water, including but not limited to a required minimum on-farm irrigation efficiency of seventy (70) percent and assurance that no tail water will leave the property. For additional information describing the conditions for receipt of Out-of-District service, refer to the Out-of-District Surface Irrigation Agreement included in Attachment C.

Additionally, the pricing structure for lands currently proposed for annexation into OID and future annexations into OID will be based at least in part on quantity delivered and assessed through volumetric measurement at the delivery point.

Moving forward, and in conjunction with improved delivery measurement, OID is planning to develop a new pricing structure based, at least in part, on the quantity of water delivered for in-District customers. This pricing structure will ensure compliance with SBx7-7. OID's plan for developing and adopting a volumetric pricing structure is described in greater detail in Section 7 and Attachment D.

3.9 Water Shortage Allocation Policies and Contingency Plan

OID recognizes that there will be times when the surface water supplies available to the District are insufficient to meet the water demands of the crops grown. As a result, the District has an explicit surface water shortage policy. The District's current policy for surface water shortages was adopted in December 2008 and is included as Attachment E of this AWMP.

The surface water shortage policy (Policy) is based on a set of eight guiding principles including its obligation under the Water Code to manage and deliver water in a reasonable and beneficial manner and its desire to provide equitable water delivery service. The policy includes suspension of surface water deliveries once available supplies are exhausted but allows for intra-district water transfers and the use of available groundwater from OID wells.

Under a Level One shortage, when the District's allocation is between 270,000 and 299,000 acre-feet, any or all of the following actions are to be taken:

- Suspend out of District agreements
- Increase the use of District wells
- Eliminate ten-day rotations and increase rotation interval to correspond to an estimated 2.4 inches of soil moisture depletion

Under a Level Two shortage, when the District's allocation is between 240,000 and 269,000 acre-feet, the following actions are to be taken, in order:

- All Level One actions
- Implement a Rotation Allocation Program (see Attachment E)
- Provide irrigation water for agricultural purposes only

Under a Level Three shortage, when the District's allocation is below 240,000 acre-feet, the following actions are to be taken, in order:

- All Level One and Level Two actions

- Implement zero discharge policy and issue monetary fines to all violators (see Attachment E)

3.10 Policies Addressing Wasteful Use of Water

OID actively prohibits the wasteful use of water, as described throughout its Rules and Regulations. Enforcement actions include withholding water for willful wasteful use. The District's policies regarding unauthorized uses of water and enforcement are described in detail in the Rules and Regulations (Attachment A).

Refer to the following rules related to prohibitions on wasteful use of water: 3030 - 3031, 3038, 3046, 4001 - 4003, 4009, 5004, 5017 - 5018, 6009 - 6010, 6013.

Refer to the following rules describing enforcement actions by the District for the wasteful use of water: 2004 - 2009, 3052, 3085, 4011, 5013, 5038 – 5039.

The cited rules above may not be exhaustive. The complete OID Rules and Regulations are available in Attachment A.

4. Inventory of Water Supplies

4.1 Introduction

The District has highly reliable surface water rights that serve as the primary supply source. In addition, both the District and private landowners have constructed groundwater production wells that serve primarily to supplement surface water supplies and to provide water for frost protection or other agronomic uses outside of the irrigation season. Surface water and groundwater supplies are discussed in the following sections.

4.2 Surface Water Supply

The Stanislaus River is the primary source of water supply for the District. The District's use of water is based on pre-1914 adjudicated and post-1914 appropriative rights that are shared with SSJID. After the construction of New Melones Reservoir by the U. S. Bureau of Reclamation (USBR), the District entered into an agreement with the USBR on how water was to be allocated between the Districts and the USBR. Under the 1988 Agreement, the District's receive a maximum of 600,000 acre-feet per year, as described previously in Section 1.1.

In 1858, Mr. Charles Tulloch (Figure 4-1), visionary and entrepreneur, built a small diversion dam immediately downstream of the current Tulloch Dam to distribute water to the Knights Ferry area. The system was extended down to the valley to serve 6,000 acres reaching as far downstream as Manteca (an area now served by SSJID) and a small area around Oakdale.

Figure 4-1. Charles Tulloch

The District purchased the "Tulloch Rights" from the San Joaquin Canal and Irrigation Company and the Consolidated Stanislaus Water and Power Company for the sum of $650,000 on April 28th, 1910. The District then deeded one-half interest to its sister district, the SSJID.

After purchasing the "Tulloch Rights", the districts abandoned the old miners' diversion dam and began construction of Goodwin Dam (Figure 4-2) in 1912. Goodwin Dam was completed in 1913 with a finished height of 80 feet above the bed of the Stanislaus River and a crest length of 500 feet. Main canals were constructed by both districts to deliver water to customers in the valley. The Oakdale Irrigation District constructed a main canal on both sides of the river, one 15 miles in length and one 22 miles in length to make deliveries to its customers.

In 1915, the District constructed Rodden Dam on the North Main Canal. It provides little storage and historically served primarily as a re-regulation reservoir. The role of Rodden Dam was essentially replaced by the North Side Regulating Reservoir, which was completed in 2010. The reservoir is more strategically located to allow for balancing of short-term supply demand mismatch and increases the operational pool from 100 acre-feet (effective storage for Rodden Dam) to 300 acre-feet.

Figure 4-2. Goodwin Dam

In 1925, the two districts began construction on Melones Reservoir with a storage capacity of 112,500 af. This dam was completed by the end of 1926, and each District was provided with 51,250 af of stored water. This was a post 1914 appropriation. The water supply from Melones Reservoir was sufficient for the needs of SSJID but became in insufficient for the needs of OID when ladino clover became the District's primary crop in the 1930's. To further augment its surface water supply, the District constructed 25 groundwater production wells between 1931 and 1938.

By 1938 the District was again searching for additional reservoir storage capacity to serve its constituents. In 1948, three reservoir sites were selected and named the Tri-Dam Project. Donnells and Beardsley Reservoirs were constructed on the Middle Fork of the Stanislaus River with storage capacities of 64,500 and 97,500 af, respectively. Tulloch Reservoir was constructed above Goodwin Diversion Dam with a storage capacity to 68,400 af. Goodwin Diversion Dam was also raised 7 feet in 1957 to bring its total storage capacity to 500 af. Donnells and Beardsley Reservoirs have post-1914 rights to store water.

Prior to the construction of the New Melones Dam and Reservoir by the USBR, and as part of the condemnation of the (Old) Melones Reservoir, the joint districts entered into a 1972 Stipulation and Agreement, whereby the joint districts' water rights were converted to an allocation agreement between the USBR and the districts for 654,000 af per year. In 1988, the joint Districts renegotiated the 1972 Stipulation and Agreement with the USBR. In the 1988 Agreement, the districts receive a maximum of 600,000 af per year. Based on an even split of the available supply, this equates to 300,000 af that are available to both OID and SSJID each year. In reaching this Agreement, the joint Districts agreed to relinquish 54,000 af per year of water in exchange for an obligation from the USBR to make up 33 percent of any deficiency below 600,000 af per year. In years when the inflow into New Melones Reservoir is less than 600,000 af, the District's entitlement is determined as set forth in Equation 4-1:

$$\text{Annual SSJID + OID Entitlement} = \text{Inflow} + [600{,}000\ \text{af} - (\text{inflow})] \times 0.33 \quad [4\text{-}1]$$

In addition, the District has three Stanislaus River pumps with a capacity of up to 2,260 af per year. These pumps have post-1914 appropriative water rights. The District also has reclamation pumps to reclaim water from drains for reuse within the District. These pumps have a capacity of approximately 32,560 af per year, although actual pumping in recent years has been much less.

An analysis of the probability that OID's entitlement will be less than 300,000 (after splitting the total supply with SSJID) was conducted as part of OID's Water Resources Plan for the period from 1922 to 1998. Based on the analysis, it was estimated that OID will receive its full supply in 79 out of 100 years and will receive at least 249,000 af in 95 out of 100 years. The minimum supply OID will likely receive in any year is approximately 190,000 af. The exceedance probability of the OID Stanislaus River water supply is shown in Figure 4-3.

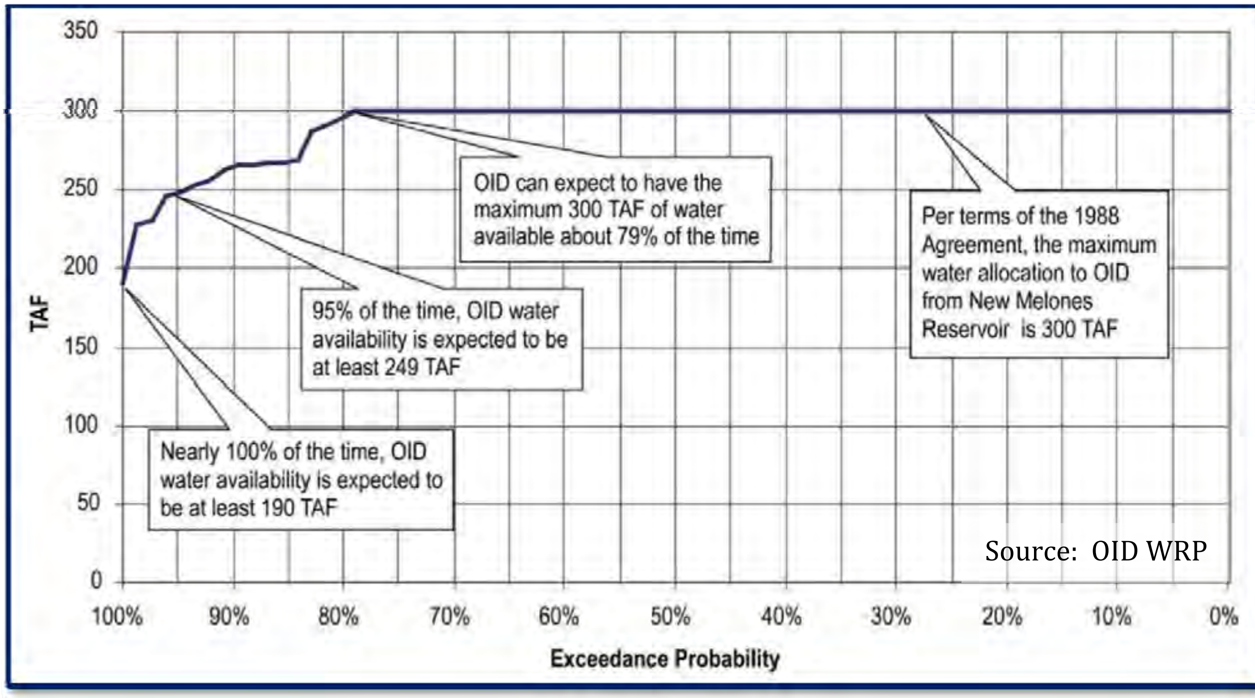

Figure 4-3. Exceedance Probability of OID Stanislaus River Water Supply

4.3 Groundwater Supply

Most of OID lies over the Riverbank and Turlock Lake Formations, which are characterized as unconsolidated deposits of sands, gravels and silts, with groundwater occurring under unconfined and semi-confined conditions (USGS 2004). The Riverbank Formation varies in thickness from 150 feet to 250 feet and generally sustains moderate well yields. The Turlock Lake Formation varies in thickness from 300 feet to 850 feet and generally sustains large well yields, up to 2,000 gallons per minute (gpm).

The Riverbank and Turlock Lake Formations lie over the consolidated Mehrten Formation, which outcrops to the east of OID. The Corcoran Clay Formation, which is present throughout much of the San Joaquin Valley, is not present beneath OID. This explains why groundwater beneath OID occurs under unconfined and semi-confined conditions rather than confined conditions.

OID lies over two groundwater subbasins as defined by the Department of Water Resources (DWR 2003) (Figure 4-4). On the south side of the Stanislaus River, the District overlies the Modesto Groundwater Subasin which is bounded on the west by the San Joaquin River, on the north by the Stanislaus River, on the south by the Tuolumne River and by the foothills on the east. On the north

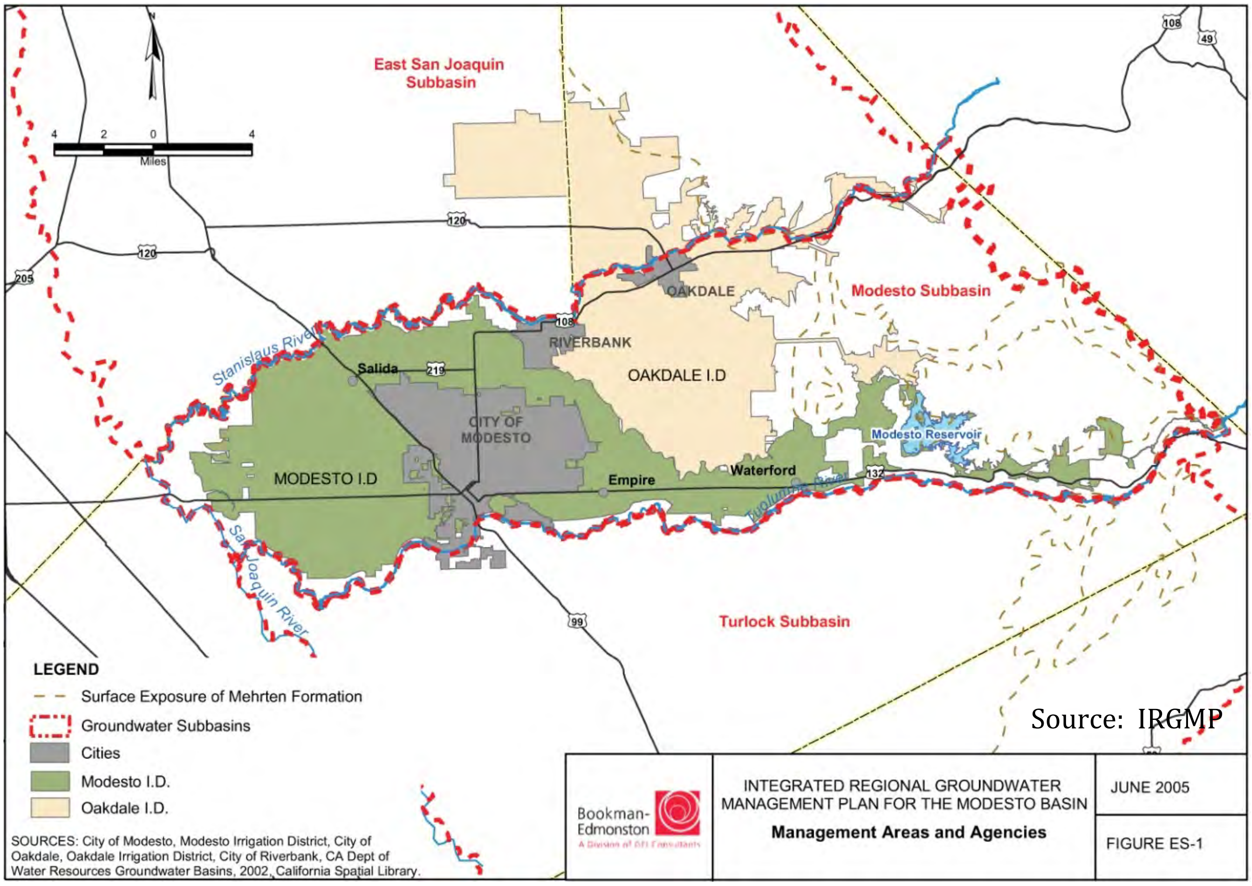

Figure 4-4. Groundwater Basins Underlying OID and Surrounding Areas

side of the Stanislaus River, the District is in the southern portion of the Eastern San Joaquin Groundwater Subbasin bounded by the San Joaquin River on the west, the Sacramento/San Joaquin County line on the north, the Stanislaus River on the south and the foothills on the east. About 60% of the District overlies the Modesto Subbasin with the remainder overlying the East San Joaquin Subbasin. The direction of groundwater flow in both of these basins is southwesterly.

On average, groundwater levels in the Modesto Subbasin declined by nearly 15 feet in the 30-year period from 1970 to 2000 (DWR 2003). This has not been a steady decline, rather one characterized by marked declines during dry periods and stabilization and recovery during wet periods. Since OID's diversions were relatively uniform throughout the 1970 to 2000 period, this suggests that subbasin groundwater levels are sensitive to variation in precipitation and possibly streamflow.

In the Eastern San Joaquin Subbasin, groundwater levels have declined significantly and nearly continuously over the past 40 years (DWR 2003). During this period, the average drop across the subbasin has been about 70 feet, or 1.7 feet per year, although water levels have dropped by more than 100 feet in some areas. However, in the portion of the subbasin beneath OID, water levels have decreased much less due to the steady recharge that occurs from OID's diversion and delivery of Stanislaus River water. The conjunctive management of surface water and groundwater resources in the subbasins underlying OID is an important consideration in evaluating the OID water balance and opportunities and potential impacts related to conservation at the farm, district, and basin scales.

In April 1994, OID joined with five neighboring agencies to form the Stanislaus and Tuolumne Rivers Groundwater Basin Association (STRGBA). The six agencies comprising the Association are:

- Oakdale Irrigation District
- City of Modesto
- Modesto Irrigation District
- City of Oakdale
- City of Riverbank
- Stanislaus County

Five of the six members of the Association rely on groundwater for all or a portion of their supply. The exception is Stanislaus County, which does not supply water but represents individual groundwater users. The County's role is to set policy for individual users such that water quality is protected.

The STRGBA developed an Integrated Regional Groundwater Management Plan (IRGMP) in 2005. The IRGMP builds on an original Groundwater Management Plan prepared by the Association in 1995, and includes additional elements to achieve compliance with the Groundwater Management Planning Act of 2002 (SB1938). The IRGMP covers the entire Modesto Groundwater Subbasin and the portion of the East San Joaquin Groundwater Subbasin underlying OID, thereby covering the entirety of OID. The IRGMP identifies Basin Management Objectives (BMOs) addressing:

- Maintenance of groundwater levels
- Control of groundwater quality degradation
- Protection against potential inelastic land subsidence
- Groundwater monitoring and assessment
- Evaluation of feasible water conservation measures
- Coordination and cooperation (with local, State and Federal agencies)

For additional detail, the IRGMP is included as Attachment F of this AWMP.

All District wells and selected private wells are monitored in spring (May) and fall (November). This information is reported to the Stanislaus and Tuolumne Rivers Groundwater Basin Association (STRGBA) and is used to map and evaluate water levels. STRGBA is the recognized local groundwater reporting agency for the California Statewide Groundwater Elevation Monitoring System (CASGEM). As a result, OID groundwater monitoring data is provided to and uploaded to the CASGEM system.

The District has twenty-five deep wells with a combined output of approximately ninety-six cfs and a maximum annual production capacity of approximately 38,130 af based on a 214-day irrigation season. Actual annual production ranges between approximately 1,500 and 16,000 af because the wells are not operated continuously. All deep well pumps are equipped with flowmeters.

In 2007, STRGBA conducted a comprehensive well field optimization study (Well Field Optimization Phase I) for OID and the Modesto Irrigation District (MID) (GEI 2007). The study was funded through a grant from the Department of Water Resources Local Groundwater Assistance Program and completed as one of the BMOs of the 2005 IRGMP with the goal of improving understanding of the groundwater system and its infrastructure and to develop tools for optimizing operation of the well field in conjunction with available surface water resources. The study consisted of the following primary tasks:

- Well facilities inventory and mapping
- Production well evaluations
- Development of a database management system (DMS)
- Development of a decision support system (DSS)

As part of the production well evaluations, pump efficiency tests were completed for all OID and MID deep well pumps (Figure 4-5). Additionally, the need for replacement or rehabilitation of each well was assessed, and improvement actions were prioritized to provide the greatest benefit relative to the cost. The pump efficiency tests completed as part of the study compliment and contribute to a database of tests OID has performed periodically in the past over the life of each well. Moving forward, OID periodically tests production wells to identify the need for additional maintenance to maintain acceptable levels of production and pumping efficiency, as it has done historically.

Figure 4-5. OID Irrigation Well

OID reclamation pumps are tested for pump efficiency when a noticeable decrease in production is observed. If a pump falls significantly below its design capacity, it is rebuilt or replaced before the following irrigation season. Services for pump efficiency testing on private agricultural wells are available through various local vendors.

Phase II of the study is underway as of 2012, which expands the well evaluations, DMS, and DSS to include the service areas of other water suppliers in the Basin.

4.4 Other Water Supplies

In addition to Stanislaus River water and groundwater supplies, the District accepts process water from the Sconza Candy Company (Figure 4-6), which is discharged under an NPDES permit between Sconza and the Regional Water Quality Control Board (RWQCB) and a discharge agreement between OID and Sconza. The discharge occurs year-round at an approximate rate of 1,300 gpm, producing approximately 2,100 af annually. The water is discharged into the Riverbank Lateral, and commingles with District water during the irrigation season, thereby becoming a source of up to approximately 1,150 af during the typical 214-day irrigation season. During the non-irrigation season this water is conveyed to downstream landowners for irrigation and stock water supply upon request. Otherwise, it flows to the Stanislaus River..

In addition to direct reuse of water by the District, approximately 1,200 af per year of discharge from food processing facilities within OID is provided directly to growers, partially offsetting OID irrigation demands.

4.5 Water Quality Monitoring

OID monitors surface water and groundwater quality within its service area and the surrounding areas under a combination of District and regional water management activities. These activities are described in greater detail below.

4.5.1 Surface Water

Currently, monitoring of surface water quality in OID is conducted primarily by the East San Joaquin Water Quality Coalition (ESJWQC) and the San Joaquin County and Delta Water Quality Coalition (SJCDWQC) as part of satisfying the requirements of the Central Valley Regional Water Quality Control Board's Irrigated Lands Program, also known as the Ag Waiver. OID is a member of both water quality coalitions in order to include District-owned lands in Stanislaus County and San Joaquin County, respectively. Historically, OID performed extensive water quality monitoring as an individual discharger to comply with the Ag Waiver.

Figure 4-6. Sconza Candy Manufacturing Complex north of OID Riverbank Lateral

In 2011, OID became a member of the East San Joaquin Water Quality Coalition and the San Joaquin County and Delta Water Quality Coalition. The East San Joaquin Water Quality Coalition represents District-owned lands in Stanislaus County, while the San Joaquin County and Delta Water Quality Coalition represents District-owned lands in San Joaquin County. As a member of the coalitions, costs of complying with monitoring and reporting activities are shared. Activities of the coalitions include:

- developing and implementing a water quality monitoring program for area rivers and drains;

- communicating and working with landowners to solve water quality problems, if found; and
- preparing and filing required reports with the RWQCB.

The ESJWQC monitors 33 assessment monitoring sites and six core monitoring sites. Based on the coalition's monitoring plan as of April 2012, the core sites are monitored every three years to assess water quality trends, while the assessment sites rotate to new locations every two years to ensure that all subwatersheds are fully characterized with respect to water quality.

The SJCDWQC monitors 53 assessment monitoring sites and five core monitoring sites. Based on the coalition's monitoring plan as of April 2012, the core sites are monitored every three years to assess water quality trends, while the assessment sites rotate to a new location every year to ensure that all subwatersheds are fully characterized with respect to water quality.

4.5.2 Groundwater

A groundwater monitoring plan (GMP) was developed as part of the IRGMP described previously and included as Attachment F of this AWMP. In addition to monitoring groundwater hydrology, specific goals of the GMP include developing a better understanding of the spatial variability of groundwater quality and monitoring changes in water quality over time.

Wells identified as part of the GMP include fifteen wells included in the USGS National Water Quality Assessment Program, as well as an additional twenty wells within OID's service area. Under the GMP, electrical conductivity has been measured by the District for twelve OID deep wells and eight private wells.

5. Water Balance

5.1 Introduction

This section describes the various uses of water within OID, followed by a detailed description of OID's water balances for key accounting centers within the District. For each accounting center, a detailed, multi-year water balance covering the period from 2005 to 2011 is presented. The water balance quantifies all significant inflows and outflows of water to and from the OID service area during the irrigation season. The irrigation season varies from year to year based on water needs, but approximately covers the period from March through October.

The water uses and water balances are discussed in relation to hydrologic conditions within OID, which vary from year to year. Key hydrologic drivers of water management in a given year include available surface water supply under the 1988 agreement with USBR, which is based on New Melones Reservoir inflows; precipitation within the OID service area, and evaporative demand.

5.2 Water Balance Overview

The OID water balance includes separate accounting centers for the OID distribution system, the farmed lands served by OID, and the OID drainage system. A total of twenty-nine individual flow paths are quantified as part of the water balance. A schematic of the water balance structure is provided in Figure 5-1.

In general, flow paths are quantified on a monthly basis for the irrigation season (March – October). For each accounting center, all but one flow path is determined independently based on measured data or calculated estimates, and the remaining flow path is then calculated based on the principal of conservation of mass (Equation 5-1), which states that the difference between total inflows and outflows to an accounting center for a given period of time is equivalent to the change in stored water within that accounting center. Over the course of a year, it is assumed that the change in storage is zero (Equation 5-2).

$$\text{Inflows} - \text{Outflows} = \text{Change in Storage (monthly time step)} \qquad [5\text{-}1]$$

$$\text{Inflows} - \text{Outflows} = 0 \text{ (annual time step)} \qquad [5\text{-}2]$$

The flow path that is calculated using Equation 5-2 is referred to as the "closure term" because the mass balance equation is solved or "closed" for the unknown quantity. The closure term is selected based on consideration of the availability of data or other information to support an independent estimate as well as the volume of water representing the flow path relative to the size of other flow paths. Generally speaking, the largest, most uncertain flow path is selected as the closure term.

The primary outflow from OID is crop evapotranspiration (ET). Crop ET may be derived from applied irrigation water (ET_{aw}) or from precipitation (ET_{pr}). A daily root zone water balance model was applied to partition total crop ET into ET_{aw} and ET_{pr}.

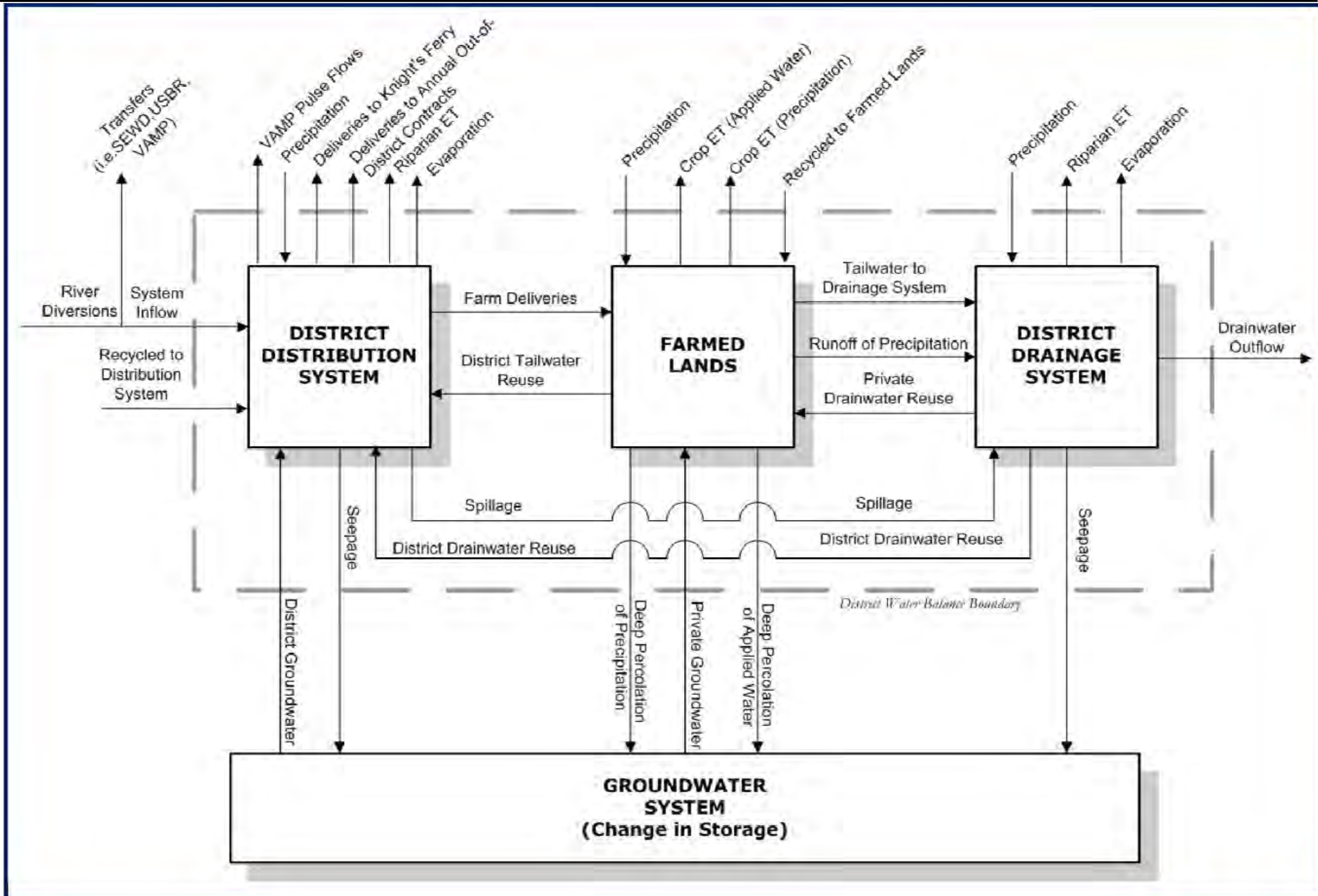

Figure 5-1. OID Water Balance Structure

5.3 Flow Path Estimation and Uncertainty

Individual flow paths were estimated based on direct measurements or based on calculations using measurements and other data. As described previously, those flow paths not estimated independently were calculated as the closure term of each accounting center.

For the OID distribution system accounting center, farm deliveries were calculated as the closure term. Farm deliveries were selected because farm deliveries represent the largest outflow from the distribution system, and detailed information describing farm deliveries is not readily available.

For the farmed lands accounting center, deep percolation of applied water was calculated as the closure term. Deep percolation of applied water was selected because it is a relatively large flow path and nearly impossible to estimate otherwise.

For the OID drainage system accounting center, tailwater was calculated as the closure term. Tailwater was selected because it represents a major source of inflow to the drainage system and little, if any, quantitative measurements of tailwater are currently available, whereas other major flow paths of operational spillage and total boundary outflows are measured for approximately 60% of OID and can be used to estimate totals for the entire district.

The results of the water balance for each flow path are reported with a high level of precision (nearest whole acre-foot) that implies a higher degree of accuracy in the values than is actually justified. While a detailed uncertainty analysis has not been conducted to assess potential error in the data and computed values, an estimated percent uncertainty (approximately equivalent to a 95% confidence interval) in each measured or calculated flow path has been estimated. Then, based on the relative magnitude of each flow path, the resulting uncertainty in each closure term can be estimated by assuming that errors in estimates are random (Clemmens and Burt 1997). Errors in estimates for individual flow paths may cancel each other out to some degree, but the net error due to uncertainty in the various estimated flow paths is ultimately expressed in the closure term.

Table 5-1 lists each flow path included in the water balance, indicating which accounting center(s) it belongs to, whether it is an inflow or an outflow, whether it was measured or calculated, the supporting data used to determine it, and the estimated uncertainty, expressed as a percent. As indicated, estimated uncertainties vary by flow path from 5% to 50% of the estimated value, with uncertainties generally being less for measured flow paths and greater for calculated flow paths. The estimated uncertainty of each closure term, calculated based on the concept of propagation of random errors as described above, is also shown for each closure term.

As indicated, the estimated uncertainty in farm deliveries is 9%. This uncertainty is relatively small due to the relatively low uncertainty in system inflows from the Stanislaus River, which represent the largest flow path in the distribution system balance. The estimated uncertainty in deep percolation of applied water is over 100%. This relatively large percent uncertainty reflects the

Table 5-1. OID Water Balance Flow Paths, Supporting Data, and Estimated Uncertainty

Accounting Center	Flowpath Type	Flowpath	Source	Supporting Data	Typical Value (af)	Estimated Uncertainty (%)
Distribution System	Inflows	System Inflows	Measurement	TriDam report, OID river pump flows	232,000	5%
		OID Groundwater Pumping	Measurement	OID deep well pump discharge measurements	7,100	5%
		OID Drainwater Reuse	Measurement	OID reclamation pump discharge measurements	9,300	5%
		OID Tailwater Reuse	Calculation	Area draining via gravity to OID distribution system, estimated tailwater production per acre as a fraction of ET of applied water	2,000	50%
		Recycled to Distribution System	Calculation	Average flow rate from discharge agreement with Sconza Candy	1,300	25%
		Precipitation	Calculation	Quality-controlled precipitation from Oakdale CIMIS station, estimated canal surface area	100	20%
	Outflows	**OID Farm Deliveries**	**Closure (Distribution System)**	**Difference of total inflows and measured/estimated outflows for Distribution System accounting center**	**187,000**	**9%**
		Deliveries to Annual Contracts	Calculation	Area served under annual contracts, OID average ET of applied water (ET_{aw}), OID average Crop Consumptive Use Fraction (CCUF)	5,700	25%
		Deliveries to Knights Ferry	Measurement	OID operational data	2,600	10%
		Transfers (VAMP Pulse Flows)	Measurement	OID operational data	1,300	10%
		Canal Riparian ET	Calculation	CIMIS reference ET, estimated crop coefficient based on SEBAL 2009 analysis, estimated riparian area	1,500	20%
		Canal Seepage	Calculation	NRCS soils data, published seepage rates by soil type, estimated wetted area, estimated wetted duration	36,000	35%
		Operational Spillage	Calculation	OID operational spill measurements, estimated area represented by measurement sites (approx. 60% of District)	17,000	25%
		Canal Evaporation	Calculation	CIMIS reference ET, estimated evaporation coefficient, estimated wetted surface area	1,700	20%
Farmed Lands	Inflows	OID Farm Deliveries	See Above			
		Private Groundwater Pumping	Calculation	Estimated groundwater only area from Water Resources Plan, average OID ET_{aw} and CCUF	19,000	35%
		Private Drainwater Reuse	Calculation	OID list of properties irrigated via gravity with drainwater only, average ET_{aw} and CCUF	3,300	30%
		Recycled to Farmed Lands	Calculation	Grower estimate of water received from food processing operation	1,200	20%
		Precipitation	Calculation	Quality-controlled precipitation from Oakdale CIMIS station, OID cropped area	15,000	10%
	Outflows	Crop ET of Applied Water (ET_{aw})	Calculation	CIMIS reference ET, estimated crop coefficients based on SEBAL 2009 analysis, cropped area by crop, Integrated Water Flow Model Demand Calculator (IDC) analysis to divide total ET into applied water and precipitation components	129,000	15%
		Tailwater to Drainage System	See Below			
		Deep Percolation of Applied Water	**Closure (Farmed Lands)**	**Difference of total inflows and measured/estimated outflows for Farmed Lands accounting center applied water balance**	**24,000**	**131%**
		OID Tailwater Reuse	See Above			
		Crop ET of Precipitation (ET_{pr})	Calculation	CIMIS reference ET, estimated crop coefficients based on SEBAL 2009 analysis, cropped area by crop, Integrated Water Flow Model Demand Calculator (IDC) analysis to divide total ET into applied water and precipitation components	22,000	15%
		Deep Percolation of Precipitation	Calculation	IDC analysis, NRCS soils characteristics, CIMIS precipitation data	15,000	25%
		Runoff of Precipitation	Calculation	IDC analysis, CIMIS precipitation data, NRCS curve number method	1,600	35%
Drainage System	Inflows	**Tailwater to Drainage System**	**Closure (Drainage System)**	**Difference of total inflows and measured/estimated outflows for Drainage System accounting center**	**55,000**	**25%**
		Operational Spillage	See Above			
		Runoff of Precipitation	See Above			
		Precipitation	Calculation	Quality-controlled precipitation from Oakdale CIMIS station, estimated drain surface area	10	20%
	Outflows	Drainwater Outflow	Calculation	OID boundary outflow measurements, estimated area represented by measurement sites (approx. 60% of District)	49,000	25%
		Drain Seepage	Calculation	NRCS soils data, published seepage rates by soil type, estimated wetted area, estimated wetted duration	12,000	35%
		OID Drainwater Reuse	See Above			
		Private Drainwater Reuse	See Above			
		Drain Evaporation	Calculation	CIMIS reference ET, estimated evaporation coefficient, estimated wetted surface area	290	20%
		Drain Riparian ET	Calculation	CIMIS reference ET, estimated crop coefficient, estimated riparian area	190	20%

fact that deep percolation of applied water is a relatively small flow path as compared to farm deliveries and crop evapotranspiration of applied water. As a result, a relatively small percent uncertainty in the large flow paths results in a relatively large uncertainty in the smaller, closure term. The estimated percent uncertainty in tailwater is 25%, which is similar to the other drainage system flow paths. Despite appreciable uncertainty in some flow path quantities, the water balance provides useful insights into OID's water management.

5.4 Hydrologic Year Types in OID

Development of a multi-year water balance allows for evaluation of water management impacts of surface water supply variability, precipitation variability, and other changes in the hydrology of OID and its surrounding area over time. Specifically, a multi-year water balance that includes both dry and wet years is essential to evaluate and plan for "planned conjunctive use of surface water and groundwater", an EWMP included in the CWC and discussed in Section 7. To support review and interpretation of water uses and overall water balance results over time, USBR surface water allocation, total water year precipitation[3], and total water year reference evapotranspiration (ET_o) are presented, and year types are assigned.

As discussed previously, OID has a reliable source of supply under its 1988 agreement with USBR which is based on inflows into New Melones Reservoir. According to an analysis conducted as part of the WRP, OID is expected to receive a full allotment in approximately eight of ten years. Based on the analysis, the amount of reduction expected in partial allotment years is relatively small (Section 4.2). During the 2005 to 2011 period, a partial allocation was provided in 2007 and 2008, with full allocations in the remaining five years.

Reduced inflows into New Melones due to reduced precipitation in the watershed typically correspond to years with reduced precipitation and increased evaporative demand in the OID service area. Based on allotment, total water year precipitation, and irrigation season reference evapotranspiration, the years 2005 to 2011 have been assigned to wet or dry year types for purposes of discussion of water uses in OID over time and the corresponding water balances. These factors along with the year types by year are listed in Table 5-2.

Based on the analysis of USBR allotment, precipitation, and ET_o, three years between 2005 and 2011 were assigned to wet year types, and four years were assigned to dry year types. The wet years of 2005, 2006, and 2010 each had a full allotment and precipitation greater than the average of 12.2 inches. March to October ET_o was least for the wet years, averaging approximately 47

[3] Total water year precipitation refers to precipitation falling within OID during the period from October through September. Precipitation beginning around October at the end of the irrigation season in a given year runs off or accumulates in the soil during the fall to winter to early spring period and is available to support crop ET in the following irrigation season. Thus, for example, the period from October 2004 to September 2005 is referred to as the 2005 water year, and precipitation occurring between October 2004 and September 2005 is referred to as 2005 total water year precipitation.

Table 5-2. 2005 to 2011 OID Allotment, Water Year Precipitation, and Irrigation Season ETo, and Hydrologic Year Type

Year	Irriga-tion Start	Irriga-tion End	Number of Days	USBR Allotment	Precipita-tion, in	ET_o, in	Hydrologic Year Type
2005	16-Apr	13-Oct	181	Full	15.4	46.8	Wet
2006	21-Apr	12-Oct	175	Full	12.7	46.6	Wet
2007	16-Mar	15-Oct	214	Partial	8.9	49.8	Dry
2008	20-Mar	10-Oct	205	Partial	9.7	51.1	Dry
2009	25-Mar	10-Oct	200	Full	9.1	49.6	Dry
2010	25-Mar	15-Oct	205	Full	19.1	46.6	Wet
2011	4-Apr	14-Oct	194	Full	10.7	45.8	Dry
				Wet Year Average	15.7	46.7	
				Dry Year Average	9.6	49.1	
				Overall Average	12.2	48.0	

inches, with the exception of 2011, which had an abnormally mild summer. The dry years of 2007 and 2008 had a partial allotment, while 2009 and 2011 had full allotments. Each of the dry years had below normal precipitation, averaging approximately 10 inches. The dry years also exhibited above average ET_o of 50 inches or more, with the exception of 2011 as previously noted.

In addition to having reduced surface water supplies in some dry years, these years have below normal precipitation, resulting in increased crop irrigation requirements. Thus, in dry years OID faces increased irrigation demands. These increased demands are coupled with reduced surface water supply in partial allocation years.

In the future, updates of the water balance will include additional years with partial allocationsto allow for an increased understanding of the implications of partial allocations on OID's water resources. The additional data will assist in the identification and implementation of management actions to increase the reliability of surface water and groundwater supplies while maintaining or improving levels of service to the water users.

5.5 Water Uses

The District supplies irrigation water for agriculture as well as domestic drinking water for subdivisions outside of the City of Oakdale service area[4]. The District co-owns three reservoirs with the SSJID that are managed by the Tri-Dam Project and Power Authority for power generation, recreation, and water sports. All of these reservoirs lie outside of OID's service area. Through the District's water conservation efforts, OID's water has been made available for environmental

[4] OID surface water is provided for agriculture. OID owns and operates a rural water system to provide groundwater for domestic drinking water and acts as the trustee for several Improvement Districts to do the same.

enhancement through water transfers. These water uses are described in greater detail in the remainder of this section.

5.5.1 Agricultural

Agricultural irrigation is by far the dominant water use in OID. Between 2005 and 2011, there was an average of 55,472 acres of crop land, including an average of 1,155 acres of fallow or idle lands. As indicated in Table 5-3 the dominant crop in OID is pasture (Figure 5-2), which was grown on an average of 32,596 acres while double-cropped summer corn and winter grain was grown on an average of 8,500 acres. Both of these crops are associated with the area's extensive livestock and dairy operations, and together account for an average of 75% of the District's total cropped area. Permanent crops in OID, including almonds, fruit trees, grapes and walnuts account for an average of 9,283 acres or 17% of the total cropped area. Rice was grown on an average of 3,626 acres or 7% of the cropped area.

Figure 5-2. Pasture near Oakdale

The WRP identifies annexation of approximately 4,250 acres within the OID sphere of influence by 2020 as part of the preferred alternative currently being implemented. Annexation provides additional funding to finance various infrastructure and operational improvements under the WRP while providing additional benefits of decreased reliance on groundwater for irrigation and increased groundwater recharge from deep percolation of surface water used for irrigation. As of 2011, OID has annexed approximately 2,100 acres and is well on track to meet WRP goals. These acreages are reflected in the OID crop acreages presented in Table 5-3 and Figure 5-3.

Table 5-3. OID Crop Acreages, 2005 to 2011

Crop	Crop Acreage by Year							Average
	2005	2006	2007	2008	2009	2010	2011	
Pasture	33,685	33,685	32,519	32,519	32,273	32,265	31,224	32,596
Oats and Corn	8,241	8,241	8,453	8,453	8,811	8,811	8,488	8,500
Almonds	3,831	3,831	5,306	5,306	6,460	6,297	8,216	5,607
Walnuts	2,143	2,143	2,584	2,584	2,734	2,712	3,174	2,582
Rice	4,442	4,442	3,476	3,476	3,476	3,411	2,656	3,626
Other	1,367	1,367	1,335	1,335	1,493	1,452	1,497	1,407
Idle	958	958	1,375	1,375	804	798	1,813	1,155
Total Cropped	53,710	53,710	53,674	53,674	55,248	54,948	55,256	54,317
Total w/Idle	54,668	54,668	55,049	55,049	56,052	55,746	57,068	55,472

1. The almond acreage includes other minor tree crops as well, including peaches, pecans, olives, pistachios, etc.

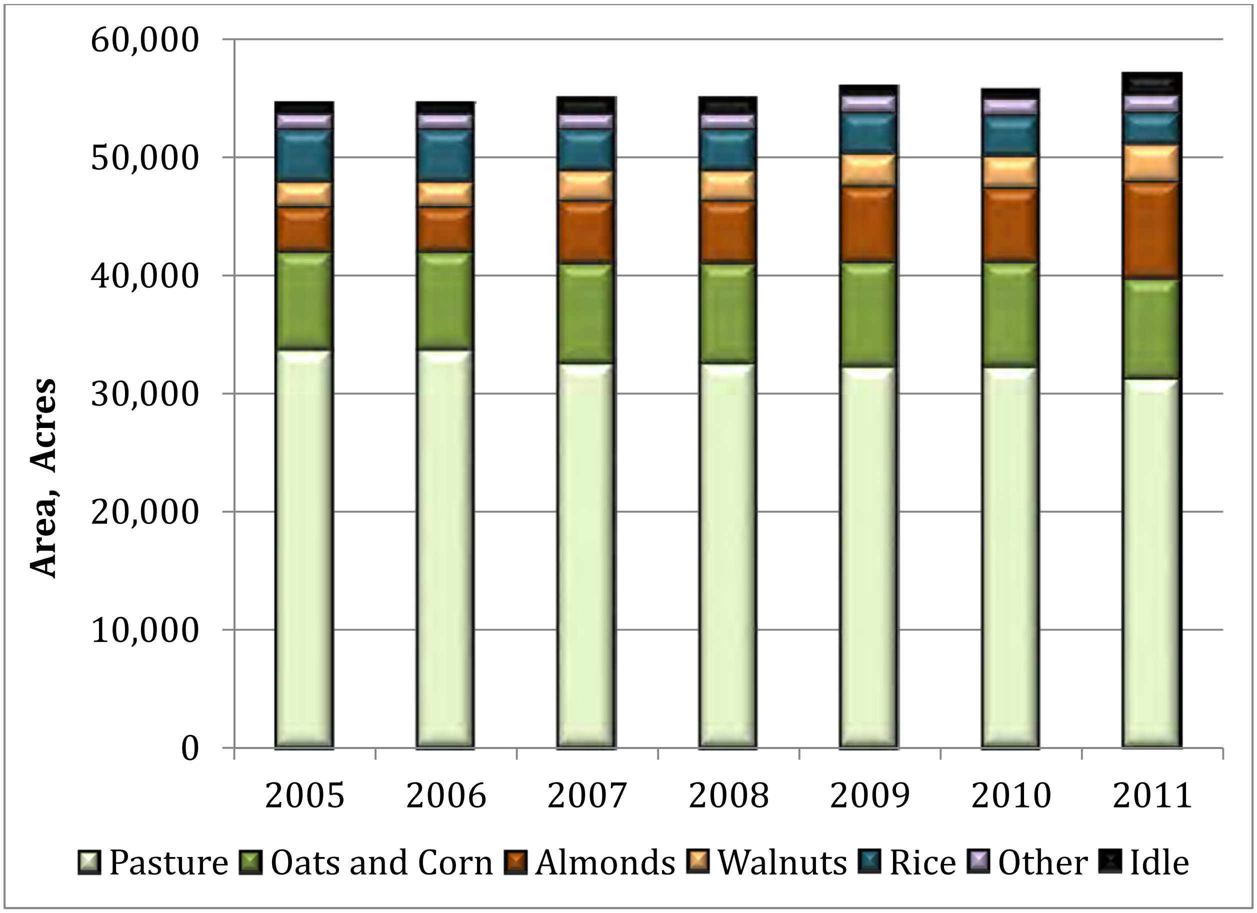

Figure 5-3. OID Cropping, 2005 to 2011

For purposes of estimating crop water requirements, an analysis of crop water use coefficients was conducted using spatially distributed actual crop evapotranspiration data developed by SEBAL North America (www.sebal.us) using the Surface Energy Balance Algorithm for Land (SEBAL®). A total of eight Landsat multispectral satellite images spanning the March to October 2009 growing season were analyzed. Total seasonal actual evapotranspiration (ET_a[5]) for the OID service area is shown in Figure 5-4.

Based on the SEBAL ET_a results and a raster coverage of 2009 cropping obtained from the USDA's National Agricultural Statistics Service (NASS) Cropland Data Layer program, consumptive use patterns of OID crops over time were determined. ET_a rates were then divided by quality-controlled reference evapotranspiration (ET_o) data from the Oakdale CIMIS station to calculate crop coefficients for the irrigation season. These crop coefficients were then combined with ET_o from other years to estimate crop ET_a over time.

[5] Note that actual ET, or ET_a, is equivalent to crop ET, or ET_c, for purposes of this AWMP. In some instances, ET_c represents optimal growing conditions due to the manner in which it is estimated and may be greater than ET_a.

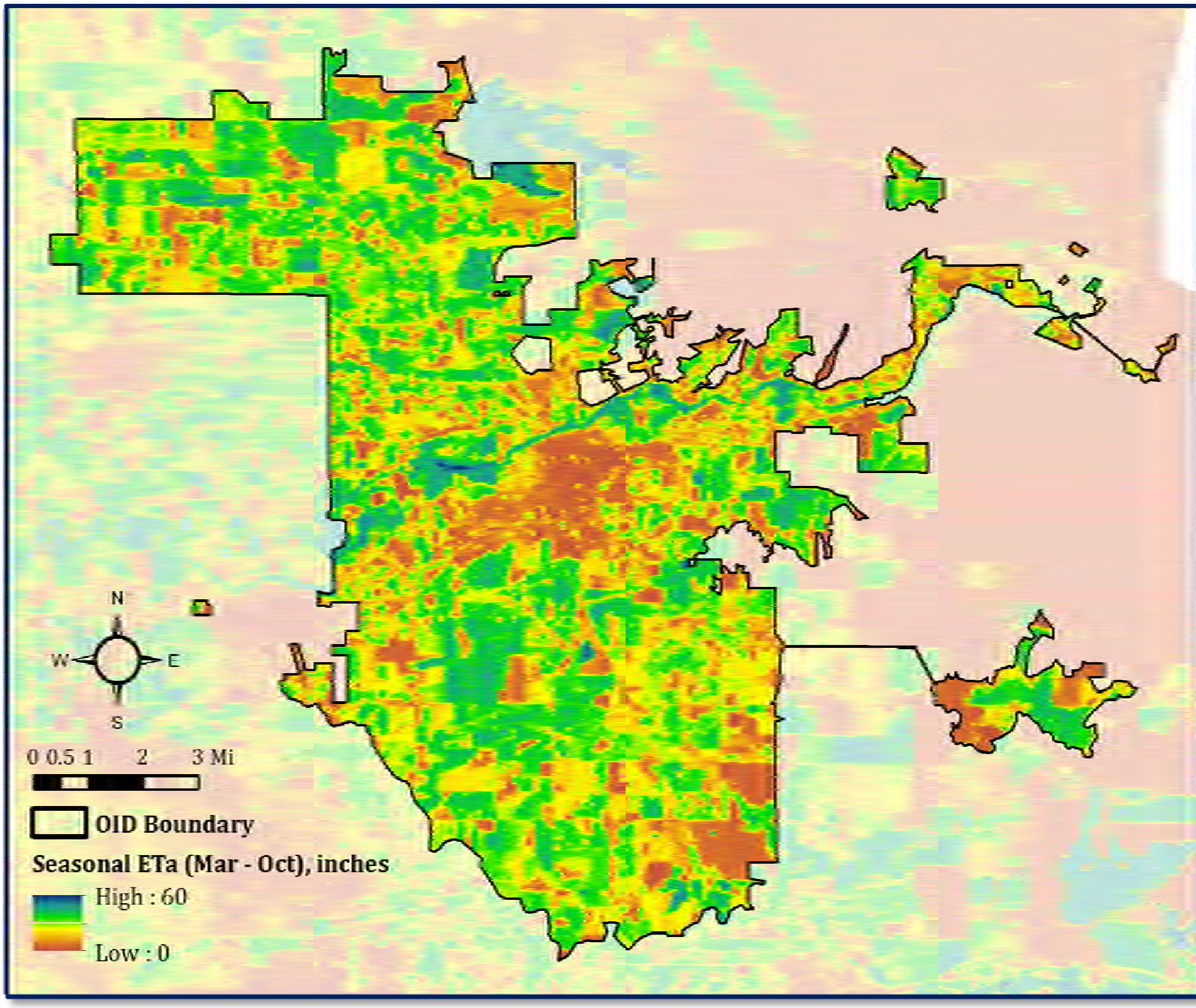

Figure 5-4. OID Spatially Distributed Seasonal Actual ET from SEBAL®, 2009 Irrigation Season

A root zone water balance simulation was run for each crop to estimate the portions of total ET supplied from applied water (ET_{aw}) and from precipitation (ET_{pr}). Unit ET values for each crop were multiplied by the corresponding cropped acres in each year to compute total water volumes consumed for agricultural purposes.

The consumptive use of water by crops in OID ranges from approximately 24 inches of total crop ET for vineyards to approximately 49 inches for walnuts (Table 5-4)[6]. ET_{aw} ranges from approximately 18 inches to 40 inches for the cropped area. Average total crop ET for pasture, OID's primary crop, is 41 inches with approximately 33 inches derived from applied irrigation water. On average, total

[6] Crop ET values are presented in Table 5-4 on a calendar year basis to capture total ET_c, ET_{aw}, and ET_{pr} within OID. The vast majority of ET_c and ET_{aw} occur during the March to October irrigation season, with some residual ET occurring following cessation of irrigation in November, particularly on pasture and orchard ground. For the water balance results presented in Section 5.6, ET results correspond to the March through October irrigation season and also include the month of November to account for crop ET_{aw} following cessation of irrigation.

crop ET in OID is 37.5 inches, with approximately 31 inches derived from applied irrigation water. The remainder of the crop ET is derived from precipitation, as described previously.

Table 5-4. Average Acreages and Annual Evapotranspiration Rates for OID Crops

Crop	Average Acres	Average Evapotranspiration (in)		
		ET_c	ET_{aw}	ET_{pr}
Almonds	5,607	35.7	28.5	7.2
Grapes[1]	1,093	24.3	17.5	6.7
Idle	1,155	6.8	0.1	6.8
Oats and Corn	8,500	26.1	22.3	3.7
Pasture	32,596	41.1	33.4	7.6
Rice	3,626	41.6	38.4	3.2
Strawberry	134	28.6	25.3	3.3
Walnuts	2,582	48.7	39.9	8.7
Totals	55,293	37.5	30.8	6.7

1. Included in category "Other" in Table 5-3 and Figure 5-3.

ET_c and ET_{aw} vary substantially between wet and dry years due to differences in overall evaporative demand and differences in the amount of accumulated rainy season precipitation available to support crop growth and offset crop irrigation requirements. For the 2005 to 2011 period, wet year ET_c averaged approximately 37 inches while dry year ET_c averaged nearly 39 inches. Wet year ET_{aw} averaged nearly 29 inches while dry year ET_{aw} averaged over 33 inches.

Additional information describing crop ET over time is included in Section 5.7. Total irrigation season crop ET varied between approximately 141,000 af and 159,000 af during the 2005 to 2011 period, with an average annual volume of 151,000 af. Approximately 129,000 af were derived from applied irrigation water (85%) and 22,000 af were derived from precipitation (15%).

Other uses of applied irrigation water include leaching of salts and frost protection for orchards and vineyards. Due to the low salinity of OID irrigation water, the required leaching fraction is small for the crops grown in the District and has not been estimated as part of this Plan. Additionally, water applied for frost protection is typically applied outside of the irrigation season and has not been estimated at this time.

5.5.2 Environmental

The District was a member of the San Joaquin River Group Authority along with Merced Irrigation District (Merced ID), Modesto Irrigation District (MID), Turlock Irrigation District (TID), South San Joaquin Irrigation District (SSJID), Friant Water Users Authority (FWUA), the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) and its member districts, and the Public Utilities Commission of the City and County of San Francisco. The San Joaquin River Agreement was a cooperative effort developed by urban, agricultural, environmental and governmental agencies to meet flow obligations at Vernalis on the San Joaquin River southeast of Tracy. Under the Agreement, the Vernalis Adaptive Management Plan (VAMP) was developed as an experimental adaptive management program designed to protect juvenile Chinook salmon during migration through the River while also evaluating the effects of flows on salmon survival. VAMP was initiated in 2000 and ended in 2011.

Under VAMP, OID and other member agencies were responsible for releasing supplemental water to provide spring (April – May) pulse flows to encourage outmigration of young fall run Chinook salmon. The required supplemental pulse flows varied from year to year depending on existing flow conditions in the River and previous year conditions. Additionally, OID made available 15,000 af of water each year to the U.S. Bureau of Reclamation (USBR), plus the difference between 11,000 af and the OID supplemental flow releases.

Thus, OID made available approximately 26,000 af in each year of the agreement, with a portion of the water used to provide spring pulse flows, which were conveyed through the OID distribution system to the Stanislaus River. The remainder of the water was made available to USBR at New Melones Reservoir to be used at the Bureau's discretion for authorized purposes. Typically USBR released the additional water during other times of the year or carried it over in storage to the following year and then released it. Objectives of releases of the additional water included various fish and wildlife benefits such as additional instream flows on the Stanislaus River during the months when fish are present, ramping of flow changes on the River following high flow periods, implementing pre-VAMP and post-VAMP ramping objectives during the spring flow period, water for fall attraction flows, temperature control in the lower Stanislaus River during the summer and fall periods, and/or storage in New Melones Reservoir for the purpose of using the additional water to augment flows in subsequent dry years.

The total volume of water provided by OID for pulse flows or to USBR for other environmental purposes on the Stanislaus and San Joaquin rivers from 2000 to 2010 is summarized in Table 5-5.

As suggested by Table 5-5, the need for OID supplemental water to increase river flows is correlated to years with partial allotments due to reduced inflow into New Melones Reservoir. During the 2005 to 2011 period, the two years in which OID provided supplemental water were the partial allocation years of 2007 and 2008.

Table 5-5. Annual OID Supplemental Water and Additional Water released to USBR under VAMP, 2000 – 2010[7]

Year	OID Supplemental Water (af)	OID Additional Water Released by USBR (af)	Total
2000	7,300	18,785	26,085
2001	7,365	18,635	26,000
2002	3,795	17,752	21,547
2003	5,039	25,424	30,463
2004	5,880	17,696	23,576
2005	-	26,033	26,033
2006[8]	-	26,000	26,000
2007	2,185	23,815	26,000
2008	7,260	18,740	26,000
2009	-	26,000	26,000
2010	-	26,000	26,000
Average	3,529	22,262	25,791

5.5.3 Recreational

The District co-owns three reservoirs with the SSJID that are managed by the Tri-Dam Project and Power Authority for power generation, recreation and water sports. These reservoirs include the Beardsley Reservoir and Donnells Reservoir (Figure 5-5) above New Melones Reservoir and Tulloch Reservoir below New Melones. All of these reservoirs lie outside of OID's service area. Water stored in the reservoirs is not "used" for recreation, per se, as it is not consumed to support recreation activities. Rather, the storage of water in the reservoirs supports recreational activities.

Figure 5-5. Donnells Reservoir

5.5.4 Municipal and Industrial

The District currently provides domestic water from District owned groundwater wells at 476 service connections within the rural water system it owns and operates. OID also serves as the trustee of six separate improvement districts (291 connections) in which water is provided from deep wells that are individually owned by each improvement district. OID staff monitors the water quality in both the RWS and improvement districts as required by state and local law. Annual use is listed in Table 5-6. A map of rural water system and improvement districts is provided in Figure 5-6.

[7] Based on San Joaquin River Group Authority annual technical reports from 2000 through 2010, available at www.sjrg.org/technicalreport/default.htm.
[8] Based on technical reports, it is unclear whether the 26,000 ac-ft released to USBR in 2006 were released for environmental benefits.

Table 5-6. Annual Use of Domestic Water

Year	Service Connections	Annual Use (af)
2005	688	1,196
2006	688	1,168
2007	688	1,261
2008	767	1,257
2009	767	1,189
2010	767	972
2011	767	1,000
Average	733	1,149

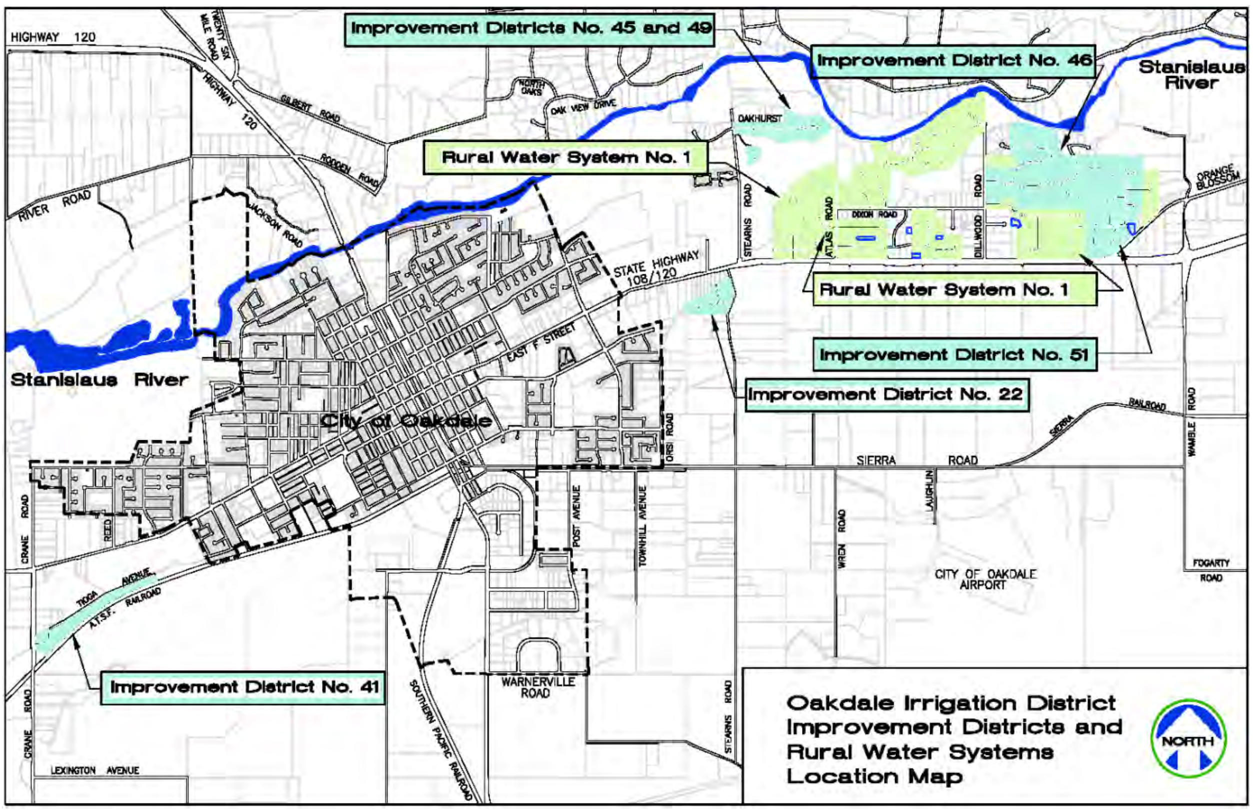

Figure 5-6. OID Improvement Districts and Rural Water Systems

The homes within the rural water systems are metered and charged accordingly. The homes within the improvement districts are not metered but have metered pumps. The District no longer allows new drinking water improvement districts so all new homes served by the District are incorporated into rural water systems.

The rural water systems and domestic water improvement districts are outside the city limits of Oakdale. Within the city limits, water is provided by the City of Oakdale (City) through a series of groundwater wells.

OID ceased deliveries of irrigation water within the city limits of Oakdale in 2005. The old age of the distribution system, disproportionately high maintenance costs, and compliance with California Government Code Title 17 were factors contributing to the discontinuation of service.

5.5.5 Groundwater Recharge

Groundwater recharge that occurs within OID consists of passive seepage from OID canals and deep percolation of precipitation and applied irrigation water. Conditions are not conducive to artificial recharge due to the extensive presence of hardpan within OID. Rather, distributed, passive recharge provides a means to replenish the East San Joaquin and Modesto subbasins to the benefit of OID water users, communities within OID and surrounding areas that share the groundwater resource.

Estimates of the passive recharge of irrigation water were derived from the water balance analysis. Canal and drain seepage were calculated based on soil characteristics along with estimated canal and drain wetted perimeters, overall lengths, and wetting frequency. Deep percolation of irrigation water was calculated as the closure term of the farmed lands water balance accounting center. Seepage and deep percolation volumes for the 2005 to 2011 study period are provided in Table 5-7, along with total recharge expressed as a volume and as a depth of water relative to the cropped area in each year.

Table 5-7. OID Total Groundwater Recharge, 2005 to 2011

Year	USBR Allotment	Hydrologic Year Type	Canal Seepage (ac-ft)	Drain Seepage (ac-ft)	Deep Percolation of Applied Water (ac-ft)	Total Recharge	
						(ac-ft)	(ac-ft/ac)
2005	Full	Wet	33,230	10,729	25,581	69,539	1.3
2006	Full	Wet	32,129	10,373	28,920	71,421	1.3
2007	Partial	Dry	39,289	12,685	35,640	87,614	1.6
2008	Partial	Dry	37,636	12,151	23,428	73,215	1.3
2009	Full	Dry	36,718	11,855	26,042	74,615	1.3
2010	Full	Wet	35,952	12,151	16,050	64,153	1.2
2011	Full	Dry	34,023	11,499	15,815	61,337	1.1
Wet Year Average			33,770	11,084	23,517	68,371	1.2
Dry Year Average			36,917	12,047	25,231	74,195	1.4
Overall Average			35,568	11,635	24,496	71,699	1.3

Total recharge between 2005 and 2011 ranged from approximately 61,000 af to 88,000 af per year, or from 1.1 af to 1.6 af per cropped acre per year. On average, total recharge was estimated to be approximately 72,000 ac-ft per year (1.3 af/ac-yr), with approximately 50% of recharge originating from canal seepage, 34% of recharge originating from deep percolation of applied water, and 16% of recharge originating as seepage from drains.

Total recharge is greater in dry years due to two primary factors. First, the irrigation season tends to begin earlier in dry years, resulting in an increased number of days during which seepage in the distribution and drainage systems occurs. Second, increased crop irrigation requirements in dry years result in increased applied irrigation water and corresponding deep percolation of applied water not consumed by the crops. Total wet year deep percolation averaged approximately 68,000 af between 2005 and 2011, while total dry year deep percolation averaged nearly 74,000 af.

Groundwater recharge net of well pumping[9] was calculated by subtracting estimated OID and private pumping volumes from total recharge volumes. Net recharge estimates for the study period are provided in Table 5-8.

Table 5-8. OID Net Groundwater Recharge, 2005 to 2011

Year	USBR Allotment	Hydrologic Year Type	Total Recharge (ac-ft)	Groundwater Pumping (ac-ft)	Net Recharge (ac-ft)	Net Recharge (ac-ft/ac)
2005	Full	Wet	69,539	21,233	48,306	0.9
2006	Full	Wet	71,421	22,263	49,158	0.9
2007	Partial	Dry	87,614	31,674	55,940	1.0
2008	Partial	Dry	73,215	39,479	33,737	0.6
2009	Full	Dry	74,615	39,544	35,071	0.6
2010	Full	Wet	64,153	26,012	38,142	0.7
2011	Full	Dry	61,337	21,677	39,660	0.7
Wet Year Average			68,371	23,169	45,202	0.8
Dry Year Average			74,195	33,093	41,102	0.7
Overall Average			71,699	28,840	42,859	0.8

Net recharge varied from approximately 34,000 af to 56,000 af per year between 2005 and 2011, or 0.6 af to 1.0 af per cropped acre per year. On average, net recharge was estimated to be approximately 43,000 af per year (0.8 af/ac-yr).

Despite greater total recharge occurring in dry years as discussed previously, net groundwater recharge tends to be greater in wet, full allocation years due to increased groundwater pumping in dry years to supplement decreased surface water supplies and/or satisfy increased crop irrigation requirements. The year 2011 is an exception primarily due to cooler than normal weather and late spring rains which resulted in a relatively late start to the irrigation season and reduced crop irrigation requirements as compared to other dry years. Additionally, net recharge was relatively large in 2007, primarily due to the long irrigation season, which resulted in additional seepage and deep percolation of applied water, as compared to other years. Net wet year groundwater recharge averaged approximately 45,000 af between 2005 and 2011, while net dry year recharge averaged approximately 41,000 af.

[9] Total groundwater pumping includes OID and private pumping for irrigation, as well as recycled water used by OID or farmed lands (see Section 4.4), which is assumed to have originated as groundwater.

5.5.6 Transfers and Exchanges

Voluntary transfers of water provide the basis for funding improvements to the OID distribution system under the District's WRP while serving to maintain water rates for OID customers. OID has participated in numerous water transfers in the past, and continues to seek opportunities for mutually beneficial transfer agreements with water users (agricultural, urban, and others) outside of the District.

OID began participating in water transfers in 1992 with a 20,000 af transfer to the State Drought Water Bank (Bank), and by the end of 2004, had transferred a total volume of 289,454 af to four different recipients, including the Bank, Stockton East Water District (SEWD), the USBR, and VAMP. Water transferred to SEWD is primarily for municipal and industrial use by the City of Stockton and the Lincoln Village and Colonial Heights Maintenance Districts. The VAMP and USBR transfers were primarily for environmental uses, such as to encourage outmigration of fall run Chinook salmon smolt (Figure 5-7), as described previously in Section 5.2.2. In addition to environmental uses, transfers to USBR are integrated into Central Valley Project (CVP) operations, enabling USBR to meet contractual water supply obligations more reliably and to comply with Delta outflow and water quality requirements.

Figure 5-7. Chinook Salmon Smolt

From 2005 to 2011, transfers included SEWD, USBR, San Luis & Delta-Mendota Water Authority and VAMP, as described in Table 5-9. Over this period, the District has transferred approximately 285,000 af, or 41,000 af per year.

Table 5-9. OID Water Transfers, 2005 to 2011

Year	Annual Transfer Volume, acre-feet				
	SEWD	VAMP Pulse Flows	USBR	San Luis & Delta-Mendota Water Authority	Total
2005	15,117	-	26,033	-	41,150
2006	14,934	-	26,000	-	40,934
2007	13,820	2,185	23,815	-	39,820
2008	15,000	7,260	18,740	-	41,000
2009	9,390	-	26,000	20,000	55,390
2010	15,000	-	26,000	-	41,000
2011	-	-	26,000	-	26,000
Totals	83,261	9,445	172,588	20,000	285,294

5.5.7 Other Water Uses

Other incidental uses of water within OID include watering of roads for dust abatement, construction water, agricultural spraying, and stock watering by OID water users. The volume of water used for such purposes is small relative to other uses and has not been quantified as part of this AWMP.

5.6 Drainage

5.6.1 Reclamation Pumping within OID

In OID, runoff from precipitation and applied irrigation water is collected in a system of private and District drains that typically follow natural drainage paths. The District has 42 reclamation pumps (Figure 5-8) located along these drains that are operated during the irrigation season to capture and reuse drainwater or to lift drainwater for reuse by MID and SSJID. Additionally, some lands within OID are irrigated all or in part through private reclamation pumping. Reclamation pumping by OID and private landowners within OID between 2005 and 2011 is summarized in Table 5-10.

Figure 5-8. Reclamation Pump

Table 5-10. Reclamation Pumping within OID, 2005 to 2011

Year	USBR Allotment	Hydrologic Year Type	Reclamation Pumping (ac-ft)		
			OID	Private	Total
2005	Full	Wet	9,932	3,108	13,040
2006	Full	Wet	8,918	3,145	12,062
2007	Partial	Dry	10,099	3,671	13,770
2008	Partial	Dry	11,092	3,695	14,787
2009	Full	Dry	9,668	3,596	13,264
2010	Full	Wet	7,729	3,137	10,866
2011	Full	Dry	7,391	3,062	10,453
Wet Year Average			8,860	3,130	11,989
Dry Year Average			9,562	3,506	13,068
Overall Average			9,261	3,345	12,606

Between 2005 and 2011, OID reclamation pumping varied between approximately 7,400 af and 11,100 af per year with an average of 9,300 af per year, and private reclamation pumping varied between 3,100 af and 3,700 af per year with an average of 3,300 af per year. Total reclamation pumping within OID varied from 10,500 af to 14,800 af per year with an average of 12,600 af per year.

The greatest reclamation pumping occurred during 2007 and 2008, years with less than full allocation of surface water supplies due to dry conditions. In general, reclamation pumping was greater in dry years than wet years in order to supplement decreased surface water supplies and/or satisfy increased crop irrigation requirements. As discussed previously, 2011 is an exception to this trend primarily due to cooler than normal weather and late spring rains which resulted in a relatively late start to the irrigation season and reduced crop irrigation requirements as compared to other dry years. Wet year reclamation pumping averaged approximately 12,000 af between 2005 and 2011, while dry year reclamation averaged approximately 13,100 af.

5.6.2 OID Boundary Outflows

As previously discussed, OID undertook and completed a systematic evaluation and ranking of the boundary flow measurement sites in 2003 for the purpose of identifying the improvements needed at each site and prioritizing measurement improvements among the sites to maximize cost effectiveness. Pursuant to the ranking of outflow sites, OID has established reliable flow measurement at seven operational spillage sites and nine drainage spill sites. The drainage spill sites represent approximately 60% of the total boundary outflows from OID. Similarly, it is estimated that the operational spillage sites represent approximately 60% of total operational spillage from the OID distribution system. The district plans to continue to increase the number of operational spill and boundary outflow sites measured over time.

More recently, a detailed analysis has been conducted by OID operations staff to delineate drainage watersheds within the District. All drainage from a given watershed leaves the District at a single location. Additionally, some "no drainage" areas exist that do not have any surface outflow. In other areas, drainage is completely captured and reused by OID or OID water users. The area of each drainage watershed was used in conjunction with boundary outflow data to estimate the total boundary outflows from OID. Additionally, the delineation of drainage watersheds enables OID to estimate drainage from individual areas, allowing for better evaluation of potential projects to reduce or recover boundary outflows for use within OID, effectively increasing the District's available surface water supply.

Estimated total boundary outflows from OID for 2005 to 2011 are summarized in Table 5-11. Total boundary outflows for the irrigation season ranged from approximately 44,000 af to 54,000 af, with an average of 49,000 af.

Based on the period from 2005 to 2011, boundary outflows do not vary substantially, on average, between wet and dry years. This is likely due in part to contrasting changes in inflows to and outflows from the district drainage system that vary depending on the hydrologic characteristics of a given year. These flow path changes are summarized qualitatively in Table 5-12.

Table 5-11. OID Boundary Outflows, 2005 to 2011

Year	USBR Allotment	Hydrologic Year Type	Seasonal Drainwater Outflow (ac-ft)
2005	Full	Wet	52,852
2006	Full	Wet	46,611
2007	Partial	Dry	49,143
2008	Partial	Dry	43,577
2009	Full	Dry	47,550
2010	Full	Wet	48,740
2011	Full	Dry	53,717
		Wet Year Average	49,401
		Dry Year Average	48,497
		Overall Average	48,884

Table 5-12. General Effects of Hydrologic Year Type on OID Drainage System Flow Paths

Drainage System Flowpath	Wet Year Effect	Dry Year Effect	Notes
Operational Spillage (Inflow)	Little or No Change	Little or No Change	Operational spillage does not appear strongly related to hydrologic year type based on currently available data. Longer irrigation seasons during dry years likely offset spillage reduction from more careful operation of the distribution system.
Farm Tailwater (Inflow)	Less	More	Increased tailwater in dry years is related to longer irrigation season and increased crop irrigation needs, resulting in increased applied water.
Runoff of Precipitation and Direct Precipitation (Inflow)	More	Less	Greater precipitation tends to occur during the irrigation season of wet years, resulting in increased runoff or precipitation and direct precipitation in the drains.
OID and Private Reclamation Pumping (Outflow)	Less	More	Increased reclamation pumping occurs in dry years to mitigate reduced surface water supply and/or increased crop irrigation requirements.
Drain Seepage (Outflow)	Less	More	Seepage tends to be greater during dry years due to a longer irrigation season.
Riparian ET and Evaporation (Outflow)	Slightly Less	Slightly More	Riparian ET and evaporation from drains tend to be slightly greater in dry years due to increased evaporative demand.

Based on the OID analysis of drainage watersheds, the destination of boundary outflows was assigned to each drainage watershed, and the volume of outflow to each drainage destination was estimated. The areas contributing to each outflow destination are shown in Figure 5-9, along with an estimate of the average seasonal boundary outflow volume.

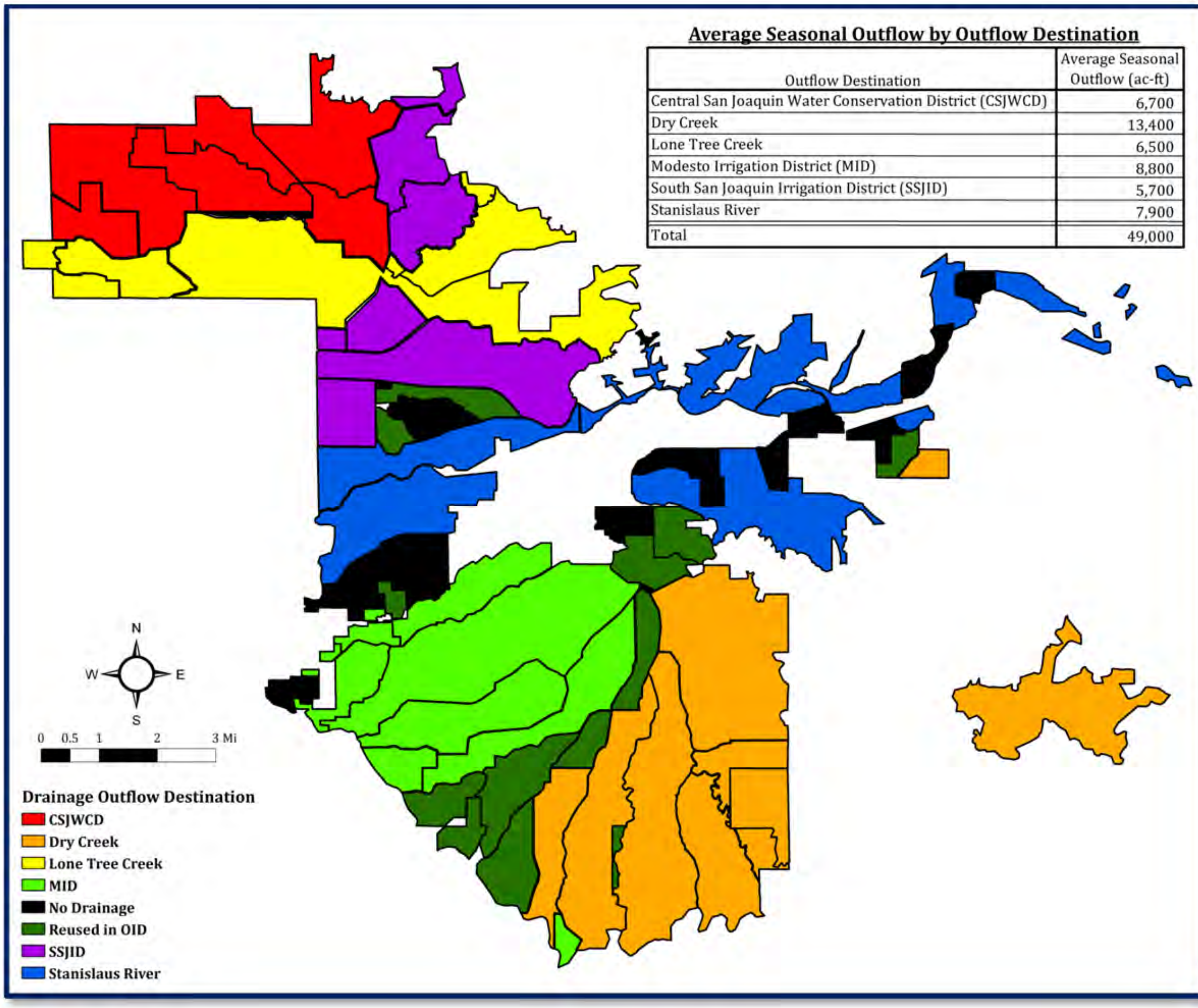

Figure 5-9. OID Drainage Watersheds, Outflow Destinations, and Average Seasonal Boundary Outflow Volume

The quality of OID drainwater has not been documented; however, it is obviously suitable for agricultural purposes, having been used for irrigation for many years in MID and SSJID.

5.7 Water Accounting (Summary of Water Balance Results)

The OID water balance structure was shown previously in Figure 5-1. The water balance was prepared for three accounting centers: (1) the OID distribution system, (2) farmed lands within OID, and (3) the OID drainage system. Additionally, the water balance can be summarized for the OID service area as a whole ("District Water Balance Boundary" shown in Figure 5-1). An accounting center representing the groundwater system is also included in Figure 5-1 to account for exchanges between the vadose zone and the aquifers underlying OID; however, a complete balance for the underlying aquifer is not calculated because not all subsurface inflows and outflows have been estimated. Tabulated water balance results for each accounting center are provided in

Tables 5-13, 5-14, and 5-15, followed by the water balance for the OID service area as a whole (Table 5-16).

As depicted in Figure 5-1, extensive interconnection occurs among the accounting centers due to recapture and reuse of water by both OID and directly by the water users. Specifically, surface runoff of water applied to farmed lands flows directly back into the District distribution system in some cases, as well as into the District drainage system. Within the drainage system, reuse of water originating as system spillage and surface runoff from farms is practiced by both the District and individual water users. These methods of water recovery and reuse result in higher levels of aggregate performance than would otherwise occur.

The water balance is presented on an annual time step for the irrigation season (approximately March through October). Underlying the annual time step is a more detailed water balance in which all flow paths are determined on a monthly or more frequent time step. The winter months are excluded because the non-irrigation season water balance is influenced by unmeasured intercepted stormwater, and the information provided does not pertain to OID water management activities.

5.7.1 Distribution System Water Balance

Over the 2005 to 2011 period, the District distribution system had total inflows from Goodwin Dam ranging from 217,000 af to 262,000 af for the irrigation season with a wet year average of 222,000 af and a dry year average of 240,000 af. The overall average for the seven year period was 232,000 af. These surface water inflows from the Stanislaus River are net of external transfers to SEWD or USBR. Diversions are greater in dry years due to the fact that less precipitation is available to support crop water demands in OID and evaporative demands tend to be greater. As a result, additional irrigation deliveries are needed to maintain crop production.

Other sources of supply include OID groundwater pumping, drainwater reuse, tailwater reuse, recycled water discharged to the OID distribution system, and precipitation directly entering the distribution system. As indicated in Table 5-12, OID groundwater pumping ranged from 1,500 af to 15,700 af between 2005 and 2011 with a wet year average of 3,100 af and a dry year average of 10,100 af. The overall average for the seven year period was 7,100 af. Additional pumping in dry years reflects increased crop water demand due to dry conditions and increased evaporative demand, as well as operation of wells by OID to offset reduced surface water supply.

OID drainwater reuse ranged from 7,400 af to 11,100 af between 2005 and 2011 with a wet year average of 8,900 af and a dry year average of 9,600 af. The overall average for the seven year period of the water balance was 9,300 af. The annual reuse of drainwater by OID is relatively steady because the cost of pumping to reclaim the water is relatively low, and the pumps are located in the lower portions of the distributions system, providing a readily available source of supply without the need to route water through the system from Goodwin Dam. Despite the relatively steady reuse of drainwater over time, pumping does tend to be greater during dry years, primarily due to increased irrigation demand. An exception is 2011, which despite being a dry year experienced relatively late rains in the spring and an abnormally mild summer.

Table 5-13. OID Distribution System Irrigation Season Water Balance Results, 2005 to 2011

				Inflows (af)						Outflows (af)								Performance Indicators	
Year	Number of Days	OID Allocation	Hydrologic Year Type	System Inflows[1]	District Groundwater Pumping	District Drainwater Reuse	Precipitation	District Tailwater Reuse	Recycled to Distribution System	Transfers (VAMP Pulse Flows)	Deliveries to Knights Ferry	Deliveries to Annual Contracts	Riparian ET	Evaporation	Operational Spillage	Seepage	**Farm Deliveries (Closure)**	Delivery Fraction	Water Management Fraction
2005	181	Full	Wet	223,706	2,054	9,932	83	2,230	1,200	0	2,786	5,941	1,377	1,600	15,024	33,230	**179,246**	0.79	0.99
2006	175	Full	Wet	225,614	1,518	8,918	49	1,950	1,160	0	2,494	5,256	1,373	1,596	18,187	32,129	**178,174**	0.78	0.99
2007	214	Partial	Dry	261,896	7,505	10,099	133	1,988	1,419	2,185	2,994	5,442	1,604	1,863	18,662	39,289	**211,000**	0.79	0.99
2008	205	Partial	Dry	244,606	14,862	11,092	15	1,875	1,359	7,260	2,876	7,665	1,600	1,859	16,689	37,636	**198,225**	0.79	0.99
2009	200	Full	Dry	234,424	15,690	9,668	93	1,848	1,326	0	2,752	5,226	1,552	1,803	16,944	36,718	**198,052**	0.79	0.99
2010	205	Full	Wet	217,143	5,683	7,729	197	1,906	1,359	0	2,390	4,277	1,479	1,718	17,351	35,952	**170,850**	0.77	0.99
2011	194	Full	Dry	218,147	2,275	7,391	153	2,132	1,286	0	2,241	5,910	1,410	1,638	14,928	34,023	**171,234**	0.78	0.99
Minimum				217,143	1,518	7,391	15	1,848	1,160	0	2,241	4,277	1,373	1,596	14,928	32,129	**170,850**	0.77	0.99
Maximum				261,896	15,690	11,092	197	2,230	1,419	7,260	2,994	7,665	1,604	1,863	18,662	39,289	**211,000**	0.79	0.99
Wet Year Average				222,154	3,085	8,860	110	2,029	1,240	0	2,557	5,158	1,410	1,638	16,854	33,770	**176,090**	0.78	0.99
Dry Year Average				239,768	10,083	9,562	98	1,961	1,347	2,361	2,716	6,061	1,541	1,791	16,806	36,917	**194,627**	0.79	0.99
Overall Average				232,220	7,084	9,261	103	1,990	1,301	1,349	2,648	5,674	1,485	1,725	16,826	35,568	**186,683**	0.79	0.99

1. System Inflows for a given year correspond to the irrigation season, which may extend into October. As a result, the total system inflows presented may occur in two, separate water years (October 1 through September 30), which is the time period applied to OID's annual allotment per the 1988 stipulation and agreement with USBR.

Table 5-14. OID Farmed Lands Irrigation Season Water Balance Results, 2005 to 2011

				Applied Water Balance										Precipitation Balance				
				Inflows (af)				Outflows (af)						Inflows (af)	Outflows (af)			
Year	Number of Days	OID Allocation	Hydro-logic Year Type	OID Farm Deliveries	Private Drainwater Reuse	Private Groundwater Pumping	Recycled to Farm Lands	Crop ET of Applied Water	Tailwater to Drainage System	District Tailwater Reuse	**Deep Percolation of Applied Water (Closure)**	Change in Storage of Applied Water (af)	Crop Consumptive Use Fraction (CCUF)	Precipitation	Crop ET of Precipitation	Runoff of Precipitation	Deep Percolation of Precipitation	**Change in Storage of Precipitation (Closure, af)**
2005	181	Full	Wet	179,246	3,108	16,811	1,168	113,548	58,975	2,230	**25,581**	0	0.57	9,476	32,817	3,049	19,746	**-46,136**
2006	175	Full	Wet	178,174	3,145	18,417	1,168	119,448	50,586	1,950	**28,920**	0	0.59	9,020	21,499	704	14,097	**-27,280**
2007	214	Partial	Dry	211,000	3,671	21,583	1,168	143,000	56,793	1,988	**35,640**	0	0.60	14,863	15,288	635	11,695	**-12,755**
2008	205	Partial	Dry	198,225	3,695	22,090	1,168	145,597	54,277	1,875	**23,428**	0	0.65	6,010	13,062	54	9,772	**-16,878**
2009	200	Full	Dry	198,052	3,596	21,361	1,168	142,542	53,744	1,848	**26,042**	0	0.64	16,349	15,389	2,461	11,019	**-12,521**
2010	205	Full	Wet	170,850	3,137	17,802	1,168	122,456	52,546	1,906	**16,050**	0	0.63	34,981	25,583	2,305	21,292	**-14,199**
2011	194	Full	Dry	171,234	3,062	16,949	1,168	115,599	58,866	2,132	**15,815**	0	0.60	16,217	30,033	2,303	18,842	**-34,961**
Minimum				170,850	3,062	16,811	1,168	113,548	50,586	1,848	**15,815**	0	0.57	6,010	13,062	54	9,772	**-46,136**
Maximum				211,000	3,695	22,090	1,168	145,597	58,975	2,230	**35,640**	0	0.65	34,981	32,817	3,049	21,292	**-12,521**
Wet Year Average				176,090	3,130	17,677	1,168	118,484	54,035	2,029	**23,517**	0	0.60	17,826	26,633	2,019	18,378	**-29,205**
Dry Year Average				194,627	3,506	20,496	1,168	136,684	55,920	1,961	**25,231**	0	0.62	13,360	18,443	1,363	12,832	**-19,279**
Overall Average				186,683	3,345	19,288	1,168	128,884	55,112	1,990	**24,496**	0	0.61	15,274	21,953	1,644	15,209	**-23,533**

Table 5-15. OID Drainage System Irrigation Season Water Balance Results, 2005 to 2011

Year	Number of Days	OID Allocation	Hydrologic Year Type	Inflows (af)				Outflows (af)					
				Operational Spillage	**Tailwater to Drainage System (Closure)**	Runoff of Precipitation	Precipitation	Drainwater Outflow	District Drainwater Reuse	Seepage	Private Drainwater Reuse	Evaporation	Riparian ET
2005	181	Full	Wet	15,024	**58,975**	3,049	10	52,852	9,932	10,729	3,108	266	171
2006	175	Full	Wet	18,187	**50,586**	704	6	46,611	8,918	10,373	3,145	265	171
2007	214	Partial	Dry	18,662	**56,793**	635	17	49,143	10,099	12,685	3,671	309	200
2008	205	Partial	Dry	16,689	**54,277**	54	2	43,577	11,092	12,151	3,695	309	199
2009	200	Full	Dry	16,944	**53,744**	2,461	12	47,550	9,668	11,855	3,596	299	193
2010	205	Full	Wet	17,351	**52,546**	2,305	25	48,740	7,729	12,151	3,137	285	184
2011	194	Full	Dry	14,928	**58,866**	2,303	19	53,717	7,391	11,499	3,062	272	176
Minimum				14,928	**50,586**	54	2	43,577	7,391	10,373	3,062	265	171
Maximum				18,662	**58,975**	3,049	25	53,717	11,092	12,685	3,695	309	200
Wet Year Average				16,854	**54,035**	2,019	14	49,401	8,860	11,084	3,130	272	176
Dry Year Average				16,806	**55,920**	1,363	12	48,497	9,562	12,047	3,506	297	192
Overall Average				16,826	**55,112**	1,644	13	48,884	9,261	11,635	3,345	286	185

Table 5-16. OID Overall Water District Water Balance Results, 2005 to 2011

Year	Number of Days	OID Allocation	Hydrologic Year Type	Inflows (af)					Outflows										Change in Storage of Precipitation (ac-ft)
				System Inflows[1]	District Groundwater Pumping	Precipitation	Private Groundwater Pumping	OID and Private Recycled	Transfers (VAMP Pulse Flows)	Deliveries to Knights Ferry	Deliveries to Annual Contracts	Drainwater Outflow	Canal and Drain Seepage	Deep Percolation of Applied Water	Deep Percolation of Precipitation	Riparian ET and Evaporation	Crop ET of Applied Water	Crop ET of Precipitation	
2005	181	Full	Wet	223,706	2,054	9,569	16,811	2,367	0	2,786	5,941	52,852	43,959	25,581	19,746	3,414	113,548	32,817	-46,136
2006	175	Full	Wet	225,614	1,518	9,076	18,417	2,328	0	2,494	5,256	46,611	42,502	28,920	14,097	3,405	119,448	21,499	-27,280
2007	214	Partial	Dry	261,896	7,505	15,012	21,583	2,586	2,185	2,994	5,442	49,143	51,973	35,640	11,695	3,976	143,000	15,288	-12,755
2008	205	Partial	Dry	244,606	14,862	6,027	22,090	2,526	7,260	2,876	7,665	43,577	49,787	23,428	9,772	3,967	145,597	13,062	-16,878
2009	200	Full	Dry	234,424	15,690	16,453	21,361	2,493	0	2,752	5,226	47,550	48,573	26,042	11,019	3,848	142,542	15,389	-12,521
2010	205	Full	Wet	217,143	5,683	35,203	17,802	2,526	0	2,390	4,277	48,740	48,104	16,050	21,292	3,667	122,456	25,583	-14,199
2011	194	Full	Dry	218,147	2,275	16,389	16,949	2,454	0	2,241	5,910	53,717	45,522	15,815	18,842	3,495	115,599	30,033	-34,961
Minimum				217,143	1,518	6,027	16,811	2,328	0	2,241	4,277	43,577	42,502	15,815	9,772	3,405	113,548	13,062	-46,136
Maximum				261,896	15,690	35,203	22,090	2,586	7,260	2,994	7,665	53,717	51,973	35,640	21,292	3,976	145,597	32,817	-12,521
Wet Year Average				222,154	3,085	17,949	17,677	2,407	0	2,557	5,158	49,401	44,855	23,517	18,378	3,495	118,484	26,633	-29,205
Dry Year Average				239,768	10,083	13,470	20,496	2,515	2,361	2,716	6,061	48,497	48,964	25,231	12,832	3,822	136,684	18,443	-19,279
Overall Average				232,220	7,084	15,390	19,288	2,469	1,349	2,648	5,674	48,884	47,203	24,496	15,209	3,682	128,884	21,953	-23,533

1. System Inflows for a given year correspond to the irrigation season, which may extend into October. As a result, the total system inflows presented may occur in two, separate water years (October 1 through September 30), which is the time period applied to OID's annual allotment per the 1988 stipulation and agreement with USBR.

OID tailwater reuse has been quite steady over time, varying between 1,900 af and 2,400 af between 2005 and 2011 with an average of approximately 2,100 af per year regardless of the year type. Similarly, the reuse of recycled water by OID has been relatively steady over time, ranging from 1,200 af to 1,400 af between 2005 and 2011 with an average of approximately 1,300 af per year. Year to year variability in recycled water reuse results primarily from changes in the irrigation season length and from changes in the volume of water generated by the Sconza Candy Company food processing operation rather than from changes in hydrology. The estimated contribution of direct precipitation to the OID water supply is very small, ranging from 15 af to 200 af between 2005 and 2011, with an average of 100 af.

Overall, OID groundwater pumping, drainwater reuse, tailwater reuse, and recycled water reuse represent a total supply of approximately 23,000 af in dry years (9% of average dry year supply) and 15,200 af in wet years (6% of average wet year supply).

The objectives of OID's water operations are to meet demands for farm irrigation (including deliveries to Knights Ferry water users and annual contracts for outside water sales) and to meet environmental needs (e.g. VAMP pulse flows, historically). Comparing total deliveries to meet irrigation demand, transfer obligations, and environmental needs to total water supply, net of precipitation (which is small and essentially impossible to manage for), a Delivery Fraction (DF) may be calculated to provide an indicator of distribution system performance. The DF is calculated on an annual (i.e., irrigation season) basis by dividing total deliveries to meet various agronomic, transfer, and environmental objectives by total supply, net of precipitation. For OID, the DF ranged from 0.77 to 0.79 between 2005 and 2011 with an average of 0.79. The DF has been similar in wet and dry years.

Losses from the distribution system at the water supplier scale include seepage, spillage, evaporation, and riparian ET[10]. Of the four loss types, only evaporation and riparian ET are non-recoverable, as seepage recharges the underlying groundwater system and spillage is available for beneficial use within OID or by down-gradient water users. Between 2005 and 2011, seepage ranged between 32,000 and 39,000 af with an average of 36,000 af for the irrigation season. The primary driver of seepage is the irrigation season length, though seepage losses have additionally been reduced following the 2009 irrigation season as a result of rehabilitating and relining portions of the South Main Canal.

Losses from operational spill varied from 15,000 af to 19,000 af between 2005 and 2011 with an average of 17,000 af per year. Spillage losses appear similar in wet and dry years. In the future, all else equal, it is anticipated that spillage losses will decrease as a result of increased regulating storage and as additional flow control and measurement structures are installed and operated; however, these reductions may be partially or fully offset by additional spillage occurring due to increased delivery flexibility to water users, which will make operation of the system more challenging for OID staff.

[10] Although riparian ET is not an intended use of OID water supplies and can be considered a loss, removal of riparian vegetation could result in environmental impacts.

Evaporation losses are relatively small and constant over time. Variations from irrigation season to irrigation season result primarily from differences in season length and evaporative demand (i.e., weather) over time. Between 2005 and 2011, evaporation losses varied from 1,600 af to 1,900 af, with an average of 1,700 af in losses per year.

Comparing total inflows to the OID distribution system available to meet irrigation and other demands (i.e., total supply) to total outflows to meet demands plus recoverable losses to seepage and spillage, a Water Management Fraction (WMF) may be calculated at the water supplier scale. This fraction is calculated on an annual basis for the irrigation season as the ratio of farm deliveries, operational spillage, and seepage to total irrigation supply. Over the period from 2005 to 2011, the WMF was consistently 0.99, indicating that essentially all of OID's water supply is used to meet demands or is recoverable for beneficial use by downgradient water users.

5.7.2 Farmed Lands Water Balance

Over the 2005 to 2011 period, OID farm deliveries ranged from 171,000 af to 211,000 af for the irrigation season with a wet year average of 176,000 af and a dry year average of 195,000 af. The overall average for the seven year period was 187,000 af. Deliveries are greater in dry years due to the fact that less precipitation is available to support crop water demands in OID and evaporative demands tend to be greater. As a result, additional irrigation deliveries are needed to maintain crop production.

Other sources of farm supply include private groundwater pumping, private drainwater pumping, and recycled water delivered directly to farms. As indicated in Table 5-13, private groundwater pumping ranged from 16,800 af to 22,100 af between 2005 and 2011 with a wet year average of 17,700 af and a dry year average of 20,500 af. The overall average for the seven year period was 19,300 af. Additional pumping in dry years reflects increased crop water demand due to dry conditions and increased evaporative demand, as well as operation of wells by growers to offset reduced surface water supply from OID.

Private drainwater reuse ranged from 3,100 af to 3,700 af between 2005 and 2011 with a wet year average of 3,100 af and a dry year average of 3,500 af. The overall average for the seven year period of the water balance was 3,300 af. Additional pumping in dry years reflects increased crop water demand due to dry conditions and increased evaporative demand, as well as operation of wells by growers to offset reduced surface water supply from OID.

Recycled water reuse is relatively steady over time due to steady generation of discharge by food processors who provide recycled water directly to growers. Recycled water use is estimated to be 1,200 af per year.

Overall, private groundwater pumping, private drainwater reuse, and recycled water reuse represent a total supply of approximately 25,200 af in dry years (11% of total supply) and 22,000 af in wet years (also 11% of total supply).

The objective of irrigation is to meet crop consumptive demand (ET_{aw}) along with any other agronomic on-farm water needs. Comparing total applied irrigation water to ET_{aw}, a Crop Consumptive Use Fraction (CCUF) may be calculated to provide an indicator of on-farm irrigation performance. The CCUF is calculated on an annual (i.e., irrigation season) basis by dividing total ETaw by total applied irrigation water. For OID, the CCUF ranged from 0.57 to 0.65 between 2005 and 2011 with an average of 0.61. The CCUF has been slightly greater in dry years than wet years, on average.

Losses from the farmed lands include tailwater (flowing to either the drainage system or back into the OID distribution system) and deep percolation of applied water. All of the losses are recoverable, as tailwater may be used by downstream water users for irrigation or other purposes, and deep percolation of applied water recharges the underlying groundwater system. Between 2005 and 2011, tailwater to the drainage system ranged between 51,000 and 59,000 af with an average of 55,000 af for the irrigation season. Tailwater to the distribution system ranged from 1,900 af to 2,400 af with an average of 2,100 af for the irrigation season.

Deep percolation of applied water varied from 16,000 af to 36,000 af between 2005 and 2011 with an average of 25,000 af per year. Deep percolation losses appear similar, on average, in wet and dry years. Annual fluctuations in deep percolation estimates result from differences in rainfall patterns and resulting applied water demands, as well as from uncertainty in the flow paths used to calculate the deep percolation amount. Due to the relatively large uncertainty in the deep percolation of applied water estimate, it is difficult to identify clear trends resulting from changes in hydrology or other factors over time. Moving forward, it is anticipated that the confidence with which deep percolation of applied water can be estimated will improve as delivery measurement accuracy improves.

5.8 Water Supply Reliability

OID requires a firm water supply to meet crop irrigation demand. The primary crops grown in OID of pasture and other forage crops are needed as a food supply to sustain beef cattle and dairy herds in the District. The remaining crops are primarily orchard and vineyard crops that additionally require a firm water supply. The reliability of OID's water supplies is discussed in detail in Section 4.

6. Climate Change

6.1 Introduction

Climate change has the potential to directly impact OID's surface water supply and to indirectly impact groundwater supplies. OID is committed to adapting to climate change in a manner that protects the water resources for the maximum benefit of the Oakdale Irrigation District community while continuing to provide excellent irrigation and domestic water service. This section includes a discussion of the potential effects of climate change on OID and its water supply, followed by a description of the resulting potential impacts on water supply and quality and on water demand. Finally, actions currently underway or that could be implemented to help mitigate future impacts are identified.

6.2 Potential Climate Change Effects

Several potential effects of climate change have been identified by the scientific community, including reduced winter snowpack, more variable and extreme weather conditions, shorter winters, and increased evaporative demand. Additionally, climate change could affect water quality through increased flooding and erosion; greater concentration of contaminants, if any, in the water supply; and warmer water which could lead to increased growth of algae and other aquatic plants. Rising sea level and increased flooding are also potential effects of climate change. OID does not serve a flood management role and is not located in the Sacramento-San Joaquin River Delta. As a result, this discussion of climate change focuses on climate change effects and impacts related to OID water supply and demand and does not discuss potential effects of rising sea level and increased flooding.

Some climate change impacts are suggested by available data describing unimpaired Stanislaus River flows from 1900 to 2011 at Goodwin Dam. Over the last 100 years, April to July unimpaired runoff as a percentage of total water year flows shows a decreasing trend (Figure 6-1), suggesting that more runoff is occurring during the winter period. Total water year runoff has not decreased substantially during this period; however recent projections reported by USBR suggest that total runoff could decrease over the next 100 years (USBR 2011), as shown in Figure 6-2. The figure shows the 5th percentile, median, and 95th percentile annual Stanislaus River runoff at New Melones Lake for 2010 to 2100 based on 112 separate hydrologic projections.

In addition to the shift of runoff from the spring to the winter period, temperatures in California have increased by approximately 1°F over the last century. All else equal, increased temperature will lead to increased crop evapotranspiration. These increases may be offset to some extent by reduced transpiration due to increased atmospheric carbon dioxide concentrations and changes in other factors that drive crop water demands, such as humidity, incoming solar radiation, and wind. An example of the potential increase in evaporative demand if temperature increases and other factors remain unchanged is shown in Figure 6-3. The figure was developed based on an analysis of monthly mean climate data from Davis, California assuming an increase in air temperature of 3°F,

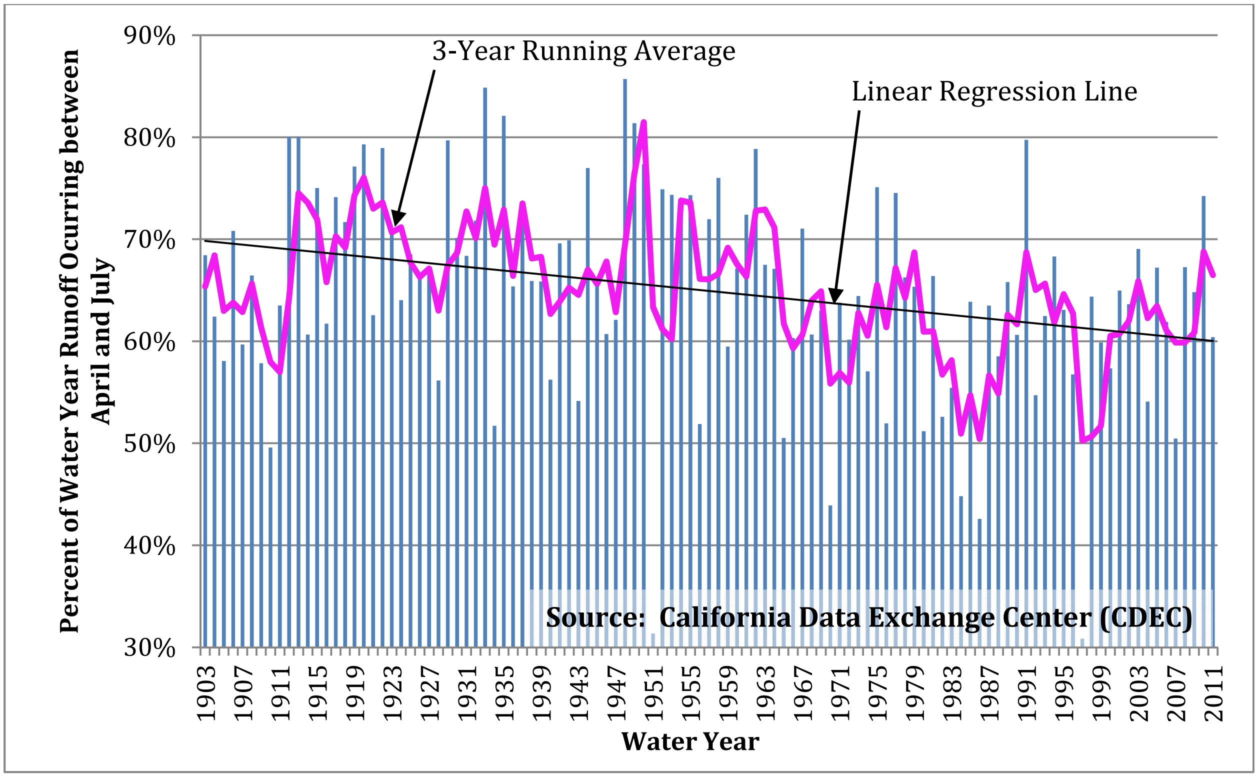

Figure 6-1. Annual April through July Unimpaired Runoff for Stanislaus River at Goodwin Dam

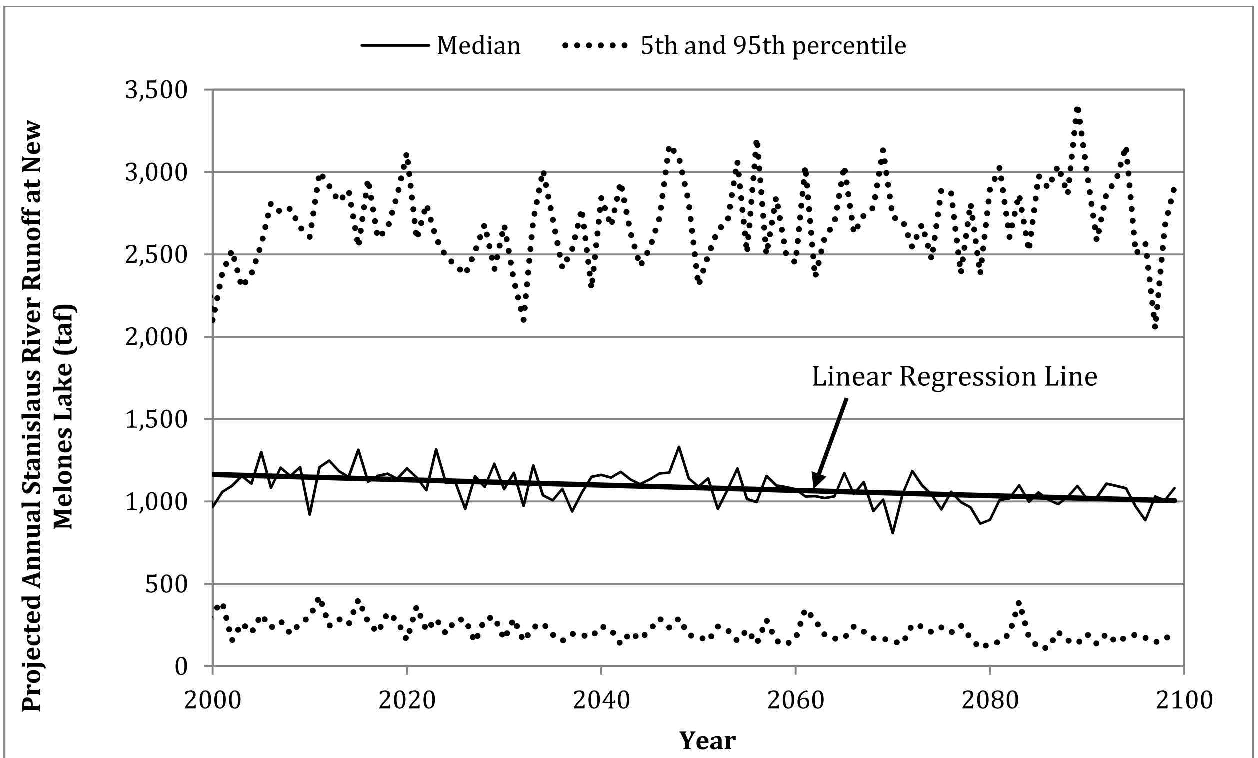

Figure 6-2. Annual Stanislaus River Runoff at New Melones Reservoir Based on 112 Hydrologic Projections (USBR 2011)

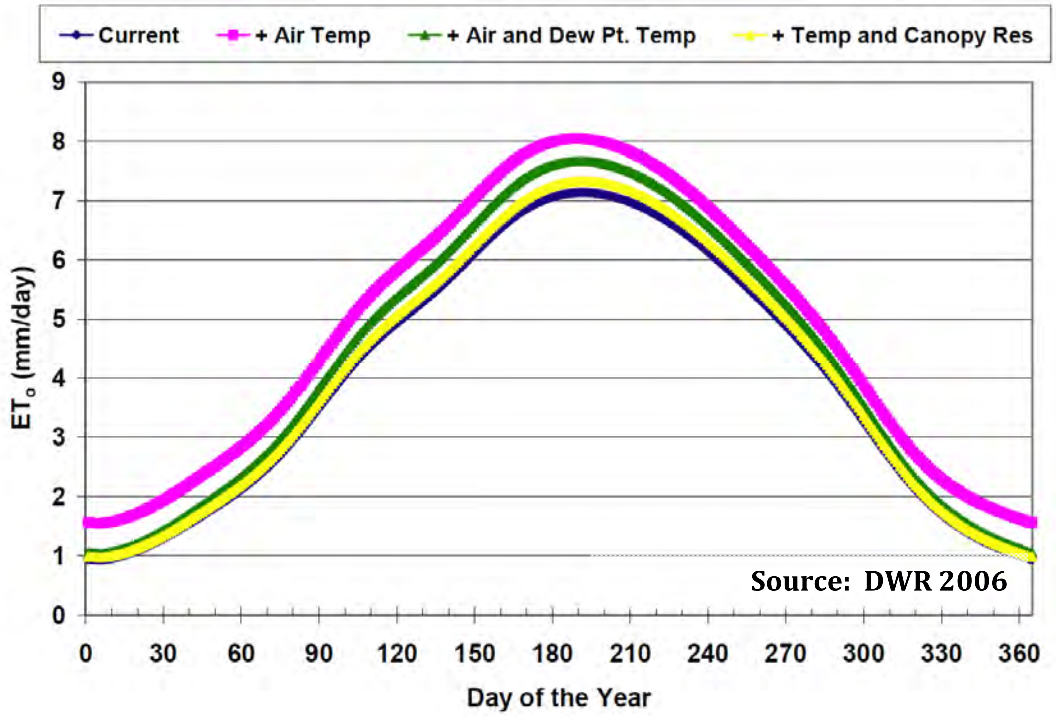

Figure 6-3. Sensitivity of Reference Evapotranspiration to Hypothetical Changes in Climate (DWR 2006)

an increase in air temperature and dew point temperature of 3°F, and finally an increase in air temperature and dew point temperature coupled with an increase in canopy resistance.

6.3 Potential Impacts on Water Supply and Quality

The shift in runoff to the winter period has the potential to impact surface water supply in the future if sufficient storage is not available to retain winter runoff until it is needed to meet irrigation demands. OID's annual entitlement is based on total annual inflows to New Melones Reservoir, so the timing of runoff will not affect OID's annual allotment.

Reduced total inflows to New Melones Reservoir in the future would increase the probability that total inflows to the reservoir would be less than 600,000 af in a given year, resulting in entitlements less than 300,000 af more often than predicted based on analysis of historical data.

Increased erosion and turbidity under climate change, if it occurred, would likely not significantly affect the water quality of the Stanislaus River as it affects agricultural irrigation. Additionally, there are no known contaminants that could be concentrated to levels that would affect agricultural irrigation if spring runoff were to decrease, particularly due to the dilution of such contaminants in reservoirs upstream of OID. Increased water temperature could result in additional challenges to OID in controlling aquatic plants in its distribution system to maintain capacity, to the extent that the increase is great enough to result in substantially increased plant growth. Increased turbidity and algae growth, if substantial, could pose challenges to filtering OID canal water for microirrigation.

6.4 Potential Impacts on Water Demand

Increased temperature and changes to other climate factors could result in increased crop water demands, as discussed previously. Additionally, changes in precipitation timing and amounts could result in greater irrigation requirements to meet ET demands. Changes in the timing of crop planting, development, and harvest could also result in changes to the timing of irrigation demands during the year.

6.5 Potential Strategies to Mitigate Climate Change Impacts

Although there is consensus that climate change is occurring, and the effects of climate change are being observed, the timing and magnitude of climate change impacts remains uncertain. OID will mitigate climate change impacts with this uncertainty in mind through an adaptive management approach in cooperation with other regional stakeholders, including municipalities within OID, neighboring irrigation districts, and USBR. Under adaptive management, key uncertainties will be identified (e.g., April – July runoff as a percentage of annual runoff, total runoff, average temperature, and reference evapotranspiration), and strategies will be developed to address the related climate change impacts. As the actual impacts occur, the strategies will be prioritized, modified as needed, and implemented.

Several strategies for agricultural water providers and other water resources entities to mitigate climate change impacts have been identified (DWR 2008, CDM 2011). These strategies include those included as part of the California Water Plan 2009 Update (DWR 2010a) as well as strategies identified as part of the California Climate Adaptation Strategy (CNRA 2009). Many of these strategies applicable to irrigation districts are already being implemented by OID in some form to meet local and regional water management objectives and will continue to serve the District well as climate change impacts occur.

Resource strategies that are being implemented or could be implemented by OID to adapt to climate change are summarized in Table 6-1.

Table 6-1. OID Position on Strategies to Mitigate Climate Change Impacts

Source	Strategy	Status
California Water Plan (DWR 2009)	Reduce water demand	OID is implementing its comprehensive water resources plan and all technically feasible EWMPs identified by SBx7-7 to achieve water use efficiency improvements in OID operations and to encourage on-farm improvements.
	Improve operational efficiency and transfers	As described above and elsewhere in this AWMP, OID is aggressively implementing improvements to increase operational efficiency within OID. Additionally, OID is an active participant in the TriDam Project and Authority as well as the San Joaquin River Group, which seek to maximize the efficiency of system operations at the regional scale. Finally, OID actively transfers water under willing seller-willing buyer agreements to satisfy agricultural, environmental, urban, and other water needs.
	Increase water supply	OID has increased its available water supply through recycling and reuse of industrial and drainage water. In the future, OID will seek additional opportunities to increase available water supply, including consideration of opportunities to increase available groundwater supply to compensate for reduced April through July runoff.
	Improve water quality	OID will continue to monitor groundwater quality as an IRGMP participant as well as monitoring the quality of surface water through its aquatic plant management activities and participation in the East San Joaquin Water Quality Coalition.
	Practice resource stewardship	OID intrinsically supports the stewardship of agricultural lands within and surrounding its service area through its irrigation operations and resulting groundwater recharge. Additionally, OID has actively supported protection of ecosystems through its participation in VAMP and by sustaining riparian habitat coincident with its irrigation and drainage systems. During the winter of 2011-2012, OID constructed a managed wetlands project at Union Slough to improve water quality in the Tuolumne River.
	Improve flood management	OID does not serve a formal flood management role, although its irrigation and drainage systems provide a passive system to collect and convey winter runoff. If runoff characteristics change substantially within OID in the future, modifications to the irrigation and/or drainage system to increase capacity or mitigate other impacts will be considered.
	Other strategies	Other strategies include crop idling, irrigated land retirement, and rainfed agriculture. Under severely reduced water supplies, OID could consider these strategies; however, it is anticipated that climate change impacts will be mitigated through the other strategies described.
California Climate Adaptation Strategy (CNRA 2009)	Aggressively increase water use efficiency	Described above under "Reduced water demand" and "Improve operational efficiency and transfers."
	Practice and promote integrated flood management	Described above under "Improve flood management."
	Enhance and sustain ecosystems	Described above under "Practice resource stewardship."
	Expand water storage and conjunctive management	Described above under "Increase water supply."
	Fix Delta water supply	Not directly applicable to OID; however, future water transfers could be used to help meet Delta water supply objectives.
	Preserve, upgrade, and increase monitoring, data analysis, and management	Through implementation of OID's Water Resources Plan, the boundary flow measurement program, the well field optimization study implemented as an action of the IRGMP, and other OID activities, the amount of information and analysis available to support OID's water management continues to increase substantially. For example, improved delivery measurement and additional operational data resulting from modernization of the distribution will enhance water management capabilities in the future.
	Plan for and adapt to sea level rise	Projections indicate that sea levels could rise by 2 to 5 feet by 2100. Direct impacts on OID are not anticipated, although OID could consider a role to help mitigate impacts to affected areas through water transfers or other means.

6.6 Additional Resources for Water Resources Planning for Climate Change

Much work has been done at State and regional levels to evaluate the effects and impacts of climate change and to develop strategies to manage available water resources effectively under climate change. The following resources provide additional information describing water resources planning for climate change:

- Progress on Incorporating Climate Change into Planning and Management of California's Water Resources. California Department of Water Resources Technical Memorandum. July 2006. (DWR 2006)
- Climate Change and Water. Intergovernmental Panel on Climate Change. June 2008. (IPC 2008)
- Managing An Uncertain Future: Climate Change Adaptation Strategies for California's Water. California Department of Water Resources Report. October 2008. (DWR 2008)
- 2009 California Climate Change Adaptation Strategy. California Natural Resources Agency Report to the Governor. December 2009. (CNRA 2009)
- Climate Change and Water Resources Management: A Federal Perspective. U.S. Geological Survey. (USGS 2009)
- Managing an Uncertain Future. California Water Plan Update 2009. Volume 1, Chapter 5. March 2010. (DWR 2010a)
- Climate Change Characterization and Analysis in California Water Resources Planning Studies. California Department of Water Resources Final Report. December 2010. (DWR 2010b)
- Climate Change Handbook for Regional Water Planning. Prepared for U.S. Environmental Protection Agency and California Department of Water Resources by CDM. November 2011. (CDM 2011)
- Climate Action Plan—Phase 1: Greenhouse Gas Emissions Reduction Plan. California Department of Water Resources. May 2012. (DWR 2012a)
- Climate Change and Integrated Regional Water Management in California: A Preliminary Assessment of Regional Perspectives. Department of Environmental Science, Policy and Management. University of California at Berkeley. June 2012. (UCB 2012)

7. Efficient Water Management Practices

7.1 Introduction

This section describes the actions that OID has taken and is planning to take to accomplish improved and more efficient water management. These actions are organized with respect to the Efficient Water Management Practices (EWMPs) described in California Water Code §10608.48 (listed previously in Section 1.2). The Code lists two types of EWMPs: those that are mandatory for all agricultural water suppliers subject to the Code and those that are mandatory if found to be technically feasible and locally cost effective.

Two mandatory EWMPs for all water suppliers are included in the Code. These include measurement of the volume of water delivered to customers with sufficient accuracy for aggregate reporting and adoption of a pricing structure based at least in part on the quantity delivered. OID is actively implementing the delivery measurement accuracy EWMP and has included a plan to comply with the agricultural water delivery measurement regulation California Code of Regulations (CCR) §597 in Attachment B. OID plans to implement volumetric pricing and has developed a plan to develop and implement pricing (Attachment D).

OID has been implementing and plans to continue implementing all additional EWMPs that are technically feasible and locally cost effective. Table 7-1 describes each critical and additional EWMP and summarizes OID's implementation status.

Table 7-1. Summary of EWMP Implementation Status (Water Code Section 10608.48 b and c)

Water Code Reference No.	EWMP Description	Implementation Status
Critical (Mandatory) Efficient Water Management Practices		
10608.48.b(1)	Measure the volume of water delivered to customers with sufficient accuracy.	Being Implemented
10608.48.b(2)	Adopt a pricing structure based at least in part on quantity delivered.	Being Implemented
Additional (Conditional) Efficient Water Management Practices		
10608.48.c(1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible
10608.48.c(2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.	Being Implemented
10608.48.c(3)	Facilitate financing of capital improvements for on-farm irrigation systems.	Being Implemented
10608.48.c(4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented
10608.48.c(5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage.	Being Implemented
10608.48.c(6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits.	Being Implemented
10608.48.c(7)	Construct and operate supplier spill and tailwater recovery systems.	Being Implemented
10608.48.c(8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area.	Being Implemented
10608.48.c(9)	Automate canal control structures.	Being Implemented

Water Code Reference No.	EWMP Description	Implementation Status
10608.48.c(10)	Facilitate or promote customer pump testing and evaluation.	Being Implemented
10608.48.c(11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented
10608.48.c(12)	Provide for the availability of water management services to water users.	Being Implemented
10608.48.c(13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented
10608.48.c(14)	Evaluate and improve the efficiencies of the supplier's pumps.	Being Implemented

7.2 Delivery Measurement Accuracy (10608.48.b(1))

OID initiated a voluntary educational pilot program of turnout measurement in the 2004 irrigation season. Since SBx7-7 was passed in November 2009, OID has evaluated and categorized all of their turnouts with respect to measurability. The District has developed standards for using USBR meter gates and constant head orifice (CHO) meter gates where applicable and other types of new standardized turnout measurement devices where CHO gates are not applicable. All turnouts and associated measurement techniques must meet the accuracy requirements of CCR 23 §597. OID has initiated an annual program to replace turnouts beginning with those categorized as unmeasurable. Approximately $150,000 has been allocated annually as a budget line item for turnout replacement annually. OID is experimenting with a new turnout measurement gate, known as a "slip meter," developed by Rubicon. The District's policy is to not allow on-farm irrigation valves to be installed on District pipelines, avoiding measurement complications facing some other water suppliers. The District's plan to comply with CCR 23 §597 is included as Attachment B.

7.3 Volumetric Pricing (10608.48.b(2))

Out-of-District Surface Irrigation Agreements are annual contracts for the delivery of OID surface water which must be approved by the BOD each year before the start of the irrigation season. Each year, OID makes a determination on the availability of any "surplus" surface irrigation water for Out-of-District Surface Irrigation Agreements. There is no guarantee that Out-of-District water will be available every year, and the water is provided at a premium rate as set annually by the BOD. The Out-of-District water rate is currently assessed either volumetrically (per acre-foot) if a District acceptable measuring device has been installed or at an equivalent fee per acre based on the applicable annual crop allocation. Several conditions must also be met prior to the receipt of Out-of-District water, including but not limited to a required minimum on-farm irrigation efficiency of seventy (70) percent and assurance that no tail water will leave the property. For additional information describing the conditions for receipt of Out-of-District service, refer to the Out-of-District Surface Irrigation Agreement included in Attachment C.

Additionally, the pricing structure for lands currently proposed for annexation into OID and future annexations into OID will be based at least in part on quantity delivered and assessed through volumetric measurement at the delivery point.

OID is evaluating options for implementing volumetric pricing and has developed a plan to develop and implement a volumetric pricing structure for in-District cutomers. The plan is included as Attachment D of this AWMP.

7.4 Additional Locally Cost Effective EWMPs

CWC §10608.48.c requires agricultural water suppliers to implement 14 additional EWMPs "if the measures are locally cost effective and technically feasible." As part of WRP implementation and general operation of the District, OID is implementing all of these measures, except one that is not technically feasible, as described in the following sections.

7.4.1 Alternative Land Use (10608.48.c(1))

The facilitate alternative land use EWMP is ***not technically feasible*** for OID because lands with exceptionally high water duties or whose irrigation contributes to significant problems (required conditions for considering this EWMP) are not found within the District boundaries, nor within the District Sphere of Influence. Furthermore, OID's rules and regulations prohibit wasteful use of water, preventing exceptional water duties or significant problems from occurring (see Section 3.10). Given the benefits to the local economy from irrigation with OID surface water and the contribution of groundwater recharge from irrigation to sustaining the regional aquifer for agricultural and municipal uses, alternative land uses are not desirable.

7.4.2 Recycled Water Use (10608.48.c(2))

OID is ***implementing*** the EWMP to facilitate use of available recycled water. The District accepts recycled water from industrial users within its service area into its system provided that the dischargers have the appropriate NPDES or other permits. Sconza Candy is a local industrial user discharging cooling water to the District distribution system as described in Sections 4 and 5 of this AWMP. OID considers requests from all qualifying permitted dischargers. Tomato processing water is also applied directly to lands within the District.

7.4.3 Capital Improvements for On-Farm Irrigation Systems (10608.48.c(3))

OID is ***implementing*** the EWMP to facilitate capital improvements for on-farm irrigation systems. District actions include active cooperation with OID water users and the NRCS to facilitate on-farm improvements through the NRCS EQIP program. The District often supplies technical assistance to facilitate these improvements. Future activities may include development and implementation of District programs to finance improvements directly.

7.4.4 Incentive Pricing Structures (10608.48.c(4))

OID is ***implementing*** this EWMP by promoting conjunctive management of surface water and groundwater supplies by setting water rates below the cost of groundwater pumping to promote surface water to provide direct and in-lieu recharge of the underlying groundwater system. In addition OID, will evaluate incentive pricing structures as part of development and adoption of a new pricing structure based at least in part on the volume of water delivered in accordance with 10608.48.b(2) as described in Attachment D. The volumetric pricing structure will promote more efficient water use at the farm level and is also expected to provide incentives for in lieu groundwater recharge by keeping water costs for irrigation lower with surface water than with groundwater.

Out-of-District Surface Irrigation Agreements are annual contracts for the delivery of OID surface water which must be approved by the BOD each year before the start of the irrigation season. Each year, OID makes a determination on the availability of any "surplus" surface irrigation water for Out-of-District Surface Irrigation Agreements. There is no guarantee that Out-of-District water will be available every year, and the water is provided at a premium rate as set annually by the BOD.

The Out-of-District water rate is currently assessed either volumetrically (per acre-foot) if a District acceptable measuring device has been installed or at an equivalent fee per acre based on the applicable annual crop allocation. Several conditions must also be met prior to the receipt of Out-of-District water, including but not limited to a required minimum on-farm irrigation efficiency of seventy (70) percent and assurance that no tail water will leave the property. For additional information describing the conditions for receipt of Out-of-District service, refer to the Out-of-District Surface Irrigation Agreement included in Attachment C.

7.4.5 Lining or Piping of Distribution System and Construction of Regulating Reservoirs (10608.48.c(5))

OID is ***implementing*** this EWMP and has 105 miles of concrete lined canals and 100 miles of buried pipeline that reduce seepage (relative to the original unlined condition). As part of the WRP, OID has invested and will continue to invest nearly $80 million in main canal and tunnels improvements and canal and lateral rehabilitation as well as $45 million in pipeline replacement through 2030. These projects will reduce seepage in aging canals and pipelines that would otherwise occur, as well as providing maintenance and operational benefits. The District has determined that additional lining or pipeline conversion of the125 miles of earthen canals that remain is not cost effective based on reduced seepage losses alone given the benefits of distributed groundwater recharge provided by unlined canals.

In addition to lining and pipeline conversion, the District completed the Robert Van Lier Regulating Reservoir in 2001 and the North Side Regulating Reservoir in 2010. SCADA controls on the reservoirs together with the phased installation of automated canal headings and the District's pilot Total Channel Control (TCC) programs on the Claribel and the Cometa laterals increase the distribution system flexibility, steadiness, and capacity while also enabling operational spillage reduction.

7.4.6 Increased Water Ordering and Delivery Flexibility (10608.48.c(6))

The District is ***implementing*** this EWMP by transitioning to an arranged demand ordering and delivery process for irrigators who require increased delivery flexibility, such as growers of orchards and corn or irrigators of small parcels. A primary goal of the WRP is to improve infrastructure to meet changing customer needs. Regulating reservoirs, automated lateral headings, and TCC are being constructed and operated to facilitate this transition. Under arranged demand, growers are typically provided water within 72 hours of placing their order with OID. As part of the WRP, OID is implementing more than $6 million in flow control and measurement improvement projects in the distribution system and $5 million in turnout replacement projects, which enable increased delivery flexibility.

7.4.7 Supplier Spill and Tailwater Recovery Systems (10608.48.c(7))

OID is ***implementing*** this EWMP. OID recovers spillage and tailwater for reuse as follows:

- Reclamation pumping within OID to recover approximately 9,300 af annually (Section 5.6.1),
- Interception and reuse of approximately 2,100 af per year of tailwater entering the OID distribution system (Section 5.7.1),
- Gravity flow and lift pumping of approximately 22,100 af per year to the neighboring districts of MID, SSJID, and CSJWCD (46 percent of total boundary outflows; see Section 5.6.2),
- Irrigation of the recently annexed, 760-acre V.A. Rodden property with recovered drainwater, and
- Planning for implementation of $11 million in outflow management projects and $6 million in reclamation projects as part of the WRP (Section 8).

Additionally, private drainwater recovery in OID results in the reuse of approximately 3,300 af of tailwater and spillage annually. Spillage and tailwater leaving OID and not recaptured by neighboring districts are available for beneficial use by other downstream water users.

In addition to recovery of operational spill, automation of the District's laterals to provide downstream control has the potential to dramatically reduce spillage through spillage prevention (as opposed to spillage recovery). Additional detail describing canal automation is provided in Section 7.4.9.

7.4.8 Increase Planned Conjunctive Use (10608.48.c(8))

The District is ***implementing*** increased planned conjunctive use through a combination of actions including construction of additional groundwater and reclamation pumping facilities (to increase available surface water and groundwater supply), implementation of outflow management projects to increase effective surface water supply, maintenance of existing groundwater and reclamation pumping facilities, strategic pricing and customer service improvements to encourage use of available surface water supplies, and participation in STRGBA. Additionally, deep percolation of applied OID surface water and seepage from OID canals and drains are a critical source of groundwater recharge to maintain a sustainable groundwater supply for users within and surrounding OID.

The STRGBA is developing a simulation/optimization model that consists of a transient model of groundwater flow coupled with optimization tools. OID has already used results of the groundwater study to identify potential areas for recharge to be protected. Furthermore, the District plans to utilize the model as a planning tool to develop optimized conjunctive use strategies to: (1) enhance groundwater production and uniformity of available groundwater supplies, (2) work with growers who have wells to encourage use of groundwater during surface water shortages, and (3) consider annexation and transfers to provide in lieu recharge through provision of surface water to adjacent groundwater users.

Additionally, OID is enhancing groundwater production capability within the District to augment surface water supplies through installation and rehabilitation of existing groundwater production wells. The goals of these improvements are to improve the reliability of groundwater production capacity within the District and to implement a coordinated strategy for groundwater production. As part of the WMP, OID is implementing $14 million in new and replacement groundwater well projects.

7.4.9 Automate Canal Control (10608.48.c(9))

OID is ***implementing*** this EWMP by automating inlets and outlets to the District regulating reservoirs described earlier. Additional automation has been implemented at the Cashman Dam and Little John Creek Diversion Dam. OID has also automated 30 canal and pipeline headings and plans to automate four additional canal and pipeline headings before the start of the 2013 irrigation season. OID has installed 31 automated flow control gates, six automated turnouts, and replaced 28 check structures as part of a pilot Total Channel Control (TCC) program on the Claribel and Cometa laterals. All of these improvements contribute to increased delivery flexibility and steadiness as well as reduced operational spills from the OID distribution system. As part of the WRP, OID has spent more than $6 million in flow control and measurement structure projects.

7.4.10 Facilitate Customer Pump Testing (10608.48.c(10))

OID is ***implementing*** this EWMP and facilitating pump testing by encouraging private pumpers within the District to utilize the Advanced Pumping Efficiency Program funded by PG&E and administered by the Center for Irrigation Technology at Fresno State University. OID provides a link to the program (www.pumpefficiency.org) on the OID web site (www.oakdaleirrigation.com).

Additionally, through participation in the STRGBA, OID together with Modesto ID received a grant to evaluate groundwater pumping efficiencies for irrigation and domestic supply. A well-field optimization study (Phase I) was completed that included pump tests for OID wells, recommendations for improvements at each well site and prioritization of energy efficiency improvements (GEI 2007).

7.4.11 Designate Water Conservation Coordinator (10608.48.c(11))

OID is ***implementing*** this EWMP by continuing to have a designated Water Conservation Coordinator (to develop and implement the water management plan and progress reports). This position was established in October 1997 and is currently filled by the District's Water Operations Manager.

7.4.12 Provide for Availability of Water Management Services (10608.48.c(12))

OID is ***implementing*** this EWMP by supporting the Oakdale CIMIS station, including assisting in station installation in 2004, and providing a link to CIMIS on the District's website (Figure 7-1). Additionally, OID disseminates cooperative extension and other agricultural information through web site links and in periodic newsletters (Figure 7-2) mailed to customers. Finally, OID provides information on mobile labs to growers.

7.4.13 Evaluate Supplier Policies to Allow More Flexible Deliveries and Storage (10608.48.c(13))

OID is ***implementing*** this EWMP through ongoing cooperation and discussion with the USBR. One example is OID's pursuit of a Warren Act Contract with Reclamation to gain carryover storage in New Melones Reservoir to provide greater dry year flexibility. OID actively attempts to identify mechanisms that allow for voluntary transfers of water within and outside of its sphere of influence that facilitate greater water supply flexibility and storage. OID actively participates in initiatives that affect its water users including the process to implement the Water Conservation Act of 2009 (SBx7-7).

Additionally, OID participates in Save the Stan, a public education program to inform the public about the NOAA Biological Opinion (BO) for the protection of Central Valley steelhead from the operations of New Melones Reservoir. In particular, the district is concerned that the BO reasonable and prudent alternatives would result in an empty New Melones Reservoir in approximately 1 of 6 years.

Figure 7-1. OID Website with Link to CIMIS

7.4.14 Evaluate and Improve Efficiencies of Supplier's Pumps (10608.48.c(14))

OID is ***implementing*** this EWMP by employing a pump tester through OID's well established program to test and evaluate the 64 pumps within the OID boundaries. These pumps include:

1. 24 deep wells to supplement surface water deliveries (conjunctive use EWMP),
2. 35 reclamation pumps to reuse drainwater within OID or lift water to the neighboring distribution systems of MID and SSJID (spill and tailwater recovery EWMP),
3. One deep well with a variable frequency drive (VFD) pump added (Furtado) (conjunctive use EWMP),

OID

The Diversion

Automated Gates to Enhance OID Service

Oakdale Irrigation District Implements TCC®

Oakdale Irrigation District (OID) has begun implementing an end-to-end pilot of Rubicon's automated gates system on two of the district's key canals, the Claribel Canal on the south side of the river and the Cometa Canal on the north. Rubicon is an Australian company which has been marketing affordable automated gates in the United States for some time. New to the U.S. market is the company's integrated canal software called Total Channel Control® (TCC). It provides a high level of water control by using a combination of sophisticated software and control engineering techniques along with wireless communications technology to integrate large networks of remotely controlled, solar powered FlumeGates™.

The system will allow OID to better use its water—improving distribution efficiency and enhancing service levels to farmers by providing a near on-demand supply. Farmers will also benefit from consistent flows rates, which the system is able to achieve by closely matching demand and supply. Efficiency improvements afforded by TCC will enable OID to further its ongoing efforts to conserve its water resources.

Both systems on the Claribel and Cometa are expected to be fully operational for the beginning of the 2011 irrigation season. The system will be evaluated over the next two irrigation seasons to gain operational knowledge prior to expansion throughout the OID delivery system.

Long Range Weather…Difficult to Predict

La Nina, the so-called current weather pattern, is notoriously known for dryer than normal precipitation patterns in the southwestern states, but it sure hasn't been the case. It was reported on the news recently that this is the wettest La Nina on record, and I don't think you'll have an argument with what we have seen so far. But winter is a long time and it's not over yet. The NOAA Climate Prediction Center is still calling for drying after January. We'll wait and see, but carry your raincoat until then. Every member of the district understands the importance of a good rain/snow season and water delivery during the summer.

Figure 7-2. Excerpt from Spring 2011 Issue of "The Diversion", OID's Irrigation Newsletter

4. One VFD booster pump (Clavey), and
5. Three pumps from the Stanislaus River, one of which is equipped with a VFD.

As previously discussed, through participation in the STRGBA, OID together with Modesto ID received a grant to evaluate groundwater pumping efficiencies for irrigation and domestic supply. A well-field optimization study (Phase I) was completed that included pump tests for OID wells, recommendations for improvements at each well site and prioritization of energy efficiency improvements (GEI 2007).

OID has budgeted $14 million under its WRP for maintenance and ongoing development of groundwater production through strategic identification of deep well sites to supplement surface water supplies and increase flexibility for water users.

7.5 Summary of EWMP Implementation Status

OID has taken many actions throughout its history to promote efficient water management and continues to review and plan additional measures to accomplish improved and more efficient water management. Water conservation is foundational to OID's 30-year WRP. Under the WRP, the transfer of water made available through conservation is the mechanism by which infrastructure and operational improvements are funded. For purposes of this AWMP, OID actions have been organized and are reported with respect to the Efficient Water Management Practices (EWMPs) listed in Water Code §10608.48. A summary of the implementation status of each listed EWMP is provided in Table 7-2.

Table 7-2. Summary of OID Implementation Status for EWMPs Listed Under CWC10608.48c

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
Critical (Mandatory) Efficient Water Management Practices				
10608.48.b(1)	Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of Section 531.10 and to implement paragraph (2).	Being Implemented	1. Evaluated and categorized all turnouts with respect to measurability. 2. Developed standards for using USBR meter gates and constant head orifice (CHO) meter gates where applicable and other types of new standardized turnout measurement devices where not applicable. 3. Dedicated annual budget line item for turnout replacement and initiated replacement of turnouts requiring corrective actions. 4. Development and implementation of a Water Measurement Plan for customer deliveries (Attachment B).	1. Continue to dedicate annual budget line item for turnout replacement 2. Continue replacement of turnouts requiring corrective actions. 3. Continue implementation of Water Measurement Plan (Attachment B).
10608.48.b(2)	Adopt a pricing structure for water customers based at least in part on quantity delivered.	Being Implemented	1. Volumetric billing for out-of-district water sales and future annexations. 2. Development and implementation of a plan to develop volumetric pricing (Attachment D).	1. Continue volumetric billing for out-of-district water sales and annexed lands. 2. Continue implementation of plan to develop volumetric pricing (Attachment D).
Additional (Conditional) efficient Water Management Practices				
10608.48.c(1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Lands with exceptionally high water duties or whose irrigation contributes to significant problems are not found within the District boundaries, nor within the District Sphere of Influence. Furthermore, OID's rules and regulations prohibit wasteful use of water, preventing exceptional water duties or significant problems from occurring.	
10608.48.c(2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils	Being Implemented	1. Sconza Candy cooling water to the district distribution system. 2. Tomato processing water is applied directly to lands within the District.	1. Continue existing use of recycled water within OID. 2. Consider requests from all qualifying permitted dischargers for additional use of recycled water.
10608.48.c(3)	Facilitate financing of capital improvements for on-farm irrigation systems	Being Implemented	1. Technical assistance to growers implementing on-farm improvements through the NRCS EQIP program.	1. Continue technical assistance to growers implementing on-farm improvements through the NRCS EQIP program.
10608.48.c(4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented	1. OID promotes conjunctive use of groundwater by setting water rates to promote surface water use (when available) over groundwater use. 2. Volumetric pricing and additional efficiency requirements apply for the receipt of out-of-district water.	1. Continue to promote use of surface water supplies 2. Include incentive pricing structure in new volumetric pricing policy.

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
10608.48.c(5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage	Being Implemented	1. Concrete lined approximately 3.3 miles of South Main Canal and tunnels in 2010 2. Concrete lined 105 miles of canals 3. Replaced 100 miles of canals with buried pipeline 4. Constructed Robert Van Lier Reservoir in 2001 5. Constructed the North Side Regulating Reservoir in 2010	1. Implement WRP main canal and tunnels improvement projects. 2. Implement WRP canal and lateral rehabilitation projects. 3. Implement WRP pipeline replacement projects.
10608.48.c(6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits	Being Implemented	1. Planned and initiated transition, within facility constraints, to an arranged demand ordering and delivery schedule for orchard and corn irrigators who require increased delivery flexibility. Under arranged demand, growers are typically provided water within 72 hours of placing their order with OID.	1. Continue transition to arranged demand ordering and delivery schedule for orchard and corn irrigators who require increased delivery flexibility. Under arranged demand, growers are typically provided water within 72 hours of placing their order with OID. As facility constraints are eased by facility modernization program, service constraints will also ease. 2. Implement WRP flow control and measurement structures projects 3. Implement WRP turnout replacement projects
10608.48.c(7)	Construct and operate supplier spill and tailwater recovery systems	Being Implemented	1. Two drainwater recovery systems irrigate more than 760 acres. OID plans to develop a drainwater collection system on the south side of the Stanislaus River. 2. Reclamation pumping within OID to recover approximately 9,300 af annually 3. Interception and reuse of approximately 2,100 af per year of tailwater entering the OID distribution system 4. Gravity flow and lift pumping of approximately 22,100 af per year to the neighboring districts of MID, SSJID, and CSJWCD 5. Automation of the District's laterals to provide downstream control has the potential to dramatically reduce spillage through spillage prevention	1. Continue discussions with potential customers outside of the District's Sphere of influence for developing a drainwater collection system. 2. Implement WRP outflow management projects. 3. Implement WRP reclamation projects.
10608.48.c(8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	Being Implemented	1. Established incentive pricing structure supporting conjunctive use. 2. Improving flexibility in water ordering and delivery to encourage use of surface water and discourage surface users from converting to groundwater. 3. Participated in regional Groundwater Management Plan Development. 4. Participating in regional development of Groundwater Model 5. Identified potential groundwater recharge areas for protection. 6. Enhancing groundwater production capability. 7. Make district pumps available for frost water use during the irrigation season when surface water not available.	1. Utilize regional groundwater model as a planning tool to develop optimized conjunctive use strategies to: (1) enhance groundwater production and uniformity of availability of GW supplies, (2) work with growers who have wells to encourage use of groundwater during surface water shortages, and (3) consider annexation and transfers to provide in lieu recharge (including adjacent groundwater users). 2. Continue improving flexibility in water ordering and delivery to encourage use of surface water and discourage surface users from converting to groundwater. 3. Implement WRP groundwater well, reclamation, and outflow management projects.

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
10608.48.c(9)	Automate canal control structures	Being Implemented	1. Automated inlets and outlets to the regulating reservoirs 2. Automated Cashman Dam and Little John Creek Diversion Dam 3. Automated 30 canal and pipeline headings 4. Installed 31 automated flow control gates and six automated turnouts 5. Installed 28 automated checks as part of a pilot TCC program on the Claribel and Cometa laterals.	1. Continue to automate the remaining canal and pipeline headings. 2. Complete pilot test of TCC and evaluate. 3. Implement WRP flow control and measurement structure projects.
10608.48.c(10)	Facilitate or promote customer pump testing and evaluation	Being Implemented	1. Promotes use of the PG&E pump testing program by private pumpers within the District. 2. Link to PG&E Ag Pump Efficiency Program on OID web site. As part of STRGBA, evaluated groundwater pumping efficiencies for irrigation and domestic supply and completed a well-field optimization study.	1. Continue to promote use of the PG&E pump testing program by private pumpers within the District.
10608.48.c(11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented	1. Designated a Water Conservation Coordinator in October 1997.	1. Continue to employ a designated Water Conservation Coordinator.
10608.48.c(12)	Provide for the availability of water management services to water users.	Being Implemented	1. Link to CIMIS on OID web site. 2. Links to cooperative extension and other agricultural information on OID web site. 3. Newsletter provided to customers. 4. Promotion of mobile labs. 5. Offer no-cost on-farm irrigation consulatations and review by OID staff upon request and as associated circumstances arise.	1. Link to CIMIS on OID web site. 2. Links to cooperative extension and other agricultural information on OID web site. 3. Newsletter provided to customers. 4. Promotion of mobile labs.
10608.48.c(13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented	1. Continuing discussions with Reclamation to obtain a Warren Act Contract with the USBR to gain carryover storage in New Melones Reservoir to provide greater dry year flexibility. 2. Identify mechanisms for voluntary transfers of water that facilitate greater water supply flexibility and storage. 3. Active participation in initiatives that affect its water users.	1. Continuing discussions with Reclamation to obtain a Warren Act Contract with the USBR to gain carryover storage in New Melones Reservoir to provide greater dry year flexibility. 2. Identify mechanisms for voluntary transfers of water that facilitate greater water supply flexibility and storage. 3. Continue active participation in initiatives that affect its water users.
10608.48.c(14)	Evaluate and improve the efficiencies of the supplier's pumps.	Being Implemented	1. Annual testing and evaluation of 64 pumps within OID boundaries by qualified staff. 2. As part of STRGBA, evaluated groundwater pumping efficiencies for irrigation and domestic supply and completed a well-field optimization study. 3. Annual maintenance and improvements as part of WRP implementation.	1. Continue testing and evaluation program for existing pumps. 2. Continue to include new wells and pumps in the existing program to evaluate and improve pump efficiencies.

7.6 Evaluation of Water Use Efficiency Improvements

CWC §10608.48(d) requires that AWMPs include:

> *… a report on which efficient water management practices have been implemented and are planned to be implemented, an estimate of the water use efficiency improvements that have occurred since the last report, and an estimate of the water use efficiency improvements estimated to occur five and 10 years in the future.*

A description of which EWMPs have been implemented has been provided previously in Section 7. This section provides an evaluation of EWMP implementation and an estimate of water use efficiency (WUE) improvements that have occurred in the past and are expected to occur in the future.

The value of evaluating water use efficiency (WUE) improvements (and EWMP implementation in general) from OID's perspective is to identify what the benefits of EWMP implementation are and to identify those additional actions that hold the potential to advance OID's mission and water management objectives. OID's mission has been and continues to be to protect and develop OID water resources for the maximum benefit of the community by providing excellent irrigation and domestic water service. Underlying this mission are the objectives of providing OID customers with a reliable, affordable, high quality supply of water. To that end, OID has taken action to develop and maintain reliable surface water and groundwater supplies, to prevent or reduce losses from the distribution system in order to increase operational efficiency, to promote the efficient use of water at the farm level, and to meet changing environmental and other demands that affect the flexibility with which the District can deliver and store water. A result of these efforts is that OID has embarked on a 25-year, comprehensive Water Resources Plan to improve the District's infrastructure and service to its customers.

First and foremost among the issues that must be considered in any evaluation of the benefits of EWMP implementation and resulting WUE improvements is how water management actions affect the water balance (Davenport and Hagan, 1982; Keller, et al., 1996; Burt, et al., 2008; Clemmens, et al., 2008; Canessa, et al., 2011). Accordingly, any evaluation of EWMP implementation and WUE improvements for OID must consider how water balance changes relate to the District's mission and water management objectives. For example, flows to deep percolation and seepage that could be considered losses in some settings are critical to maintain the long-term sustainability of the underlying groundwater basin. Reductions in these flows resulting from EWMP implementation could be considered WUE improvements at the farm or District scale, but have the consequential effect of diminishing recharge of the underlying groundwater system. Other flows that could be considered losses at the District or farm scale such as spillage and tailwater, respectively, are also recoverable. For example, spillage from the OID distribution system is available for beneficial use by downgradient water users and is actively used by MID, SSJID, and CSJWCD. The only distribution system or on-farm losses that are not recoverable within OID, the underlying groundwater basin, or the San Joaquin River Basin as a whole are canal and reservoir water surface evaporation and evaporation from irrigation application. These components represent a small portion of OID's water supply (less than one percent as indicated in Table 5-13). An implication of this is that very little "new" water can be made available through water conservation in OID.

An essential first step in evaluating EWMP implementation and water use efficiency improvements is a comprehensive, quantitative, multi-year water balance (see Section 5). The quantitative understanding of the water balance flow paths enables identification of targeted flow paths for WUE improvements, along with improved understanding of the beneficial impacts and consequential effects of EWMP implementation at varying spatial and temporal scales. The water balance enables evaluation of potential changes in flow path quantities and timing for any given change in water management.

Even where comprehensive, multi-year water balances have been developed, evaluating water balance impacts and WUE improvements is not a trivial task. Issues of spatial and temporal scale and relatively small changes in flow paths resulting from many water management improvements (relative to day to day and year to year variation in water diversions and use) coupled with inaccuracies inherent in even the best water measurement greatly complicate the evaluation of water balance impacts. The implications of recoverable and irrecoverable losses at varying scales complicate the evaluation of WUE improvements, and consequential, potentially unintended consequences must be considered. (Burns et al. 2000, AWMC 2004)

As part of assembling this AWMP, OID has identified the targeted flow paths associated with implementation of each EWMP, the water management benefits of each EWMP, along with the potential consequential effects of implementation. A brief discussion of the benefits associated with implementation of each EWMP is provided, along with a brief discussion of consequential effects that must be considered. A summary of targeted flow paths, beneficial impacts, and consequential effects associated with implementation of each EWMP by OID is provided in Table 7-3.

Table 7-3. Summary of WUE Improvements by EWMP

Water Code Reference No.	EWMP	Implementation Status	Targeted Flow Path(s)	Benefits	Consequential Effects	Notes (See End of Table)
10608.48.b (1)	Measure the volume of water delivered to customers with sufficient accuracy	Being Implemented	None	Supports Evaluation of EWMPs	Not Applicable	1
10608.48.b (2)	Adopt a pricing structure based at least in part on quantity delivered	Being Implemented	Farm Deliveries, Tailwater, Deep Percolation of Applied Water, System Inflows, Drainage Outflows	Volumetric pricing could create a modest incentive to reduce on-farm deliveries, primarily through reduced tailwater and deep percolation. In aggregate, reduced deliveries result in decreased system inflows and corresponding reductions in drainage outflows. Available water not diverted could allow for service area expansion (annexation) or be available for transfer. Additionally, water quality benefits may occur through reduced tailwater and deep percolation.	Reduced deep percolation results in reduced beneficial recharge of the underlying groundwater system, potentially contributing to groundwater overdraft. Reduced drainage outflows from tailwater result in reduced water available for beneficial use by downgradient agricultural or environmental water users.	2
10608.48.c (1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Not Applicable	Not Applicable	Not Applicable	3
10608.48.c (2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.	Being Implemented	System Inflows, Farm Deliveries	Recycled water use by OID provides a limited reduction in required surface supply. Recycled water use directly by irrigators reduces the demand for OID deliveries, further reducing required surface supply. Available water not diverted could allow for service area expansion (annexation) or be available for transfer.	Recycled water is of diminished quality as compared to OID surface water supplies.	
10608.48.c (3)	Facilitate financing of capital improvements for on-farm irrigation systems	Being Implemented	Farm Deliveries, Tailwater, Deep Percolation of Applied Water, System Inflows, Drainage Outflows	OID in-kind technical assistance to support on-farm improvements could result in limited reductions in on-farm deliveries through reduced tailwater and deep percolation. In aggregate, reduced deliveries result in decreased system inflows and corresponding reductions in drainage outflows. Available water not diverted could allow for service area expansion (annexation) or be available for transfer. Additionally, water quality benefits may occur through reduced tailwater and deep percolation.	Reduced deep percolation results in reduced beneficial recharge of the underlying groundwater system, potentially contributing to groundwater overdraft. Reduced drainage outflows from tailwater result in reduced water available for beneficial use by downgradient agricultural or environmental water users.	2
10608.48.c (4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented	Varies	Volumetric pricing will incentivize goal (A), resulting in on-farm benefits as described for the volumetric pricing EWMP (10608.48.b(2)). Provision of surface water at lower rates than the cost of groundwater pumping incentivizes goals (B) and (C) and improves the reliability of regional water supplies.	Consequential effects of volumetric pricing are the same as described for the volumetric pricing EWMP (10608.48.b(2)). Many of these efficiency improvements require the use of electricity as a component, increasing the need for greater energy demands.	2

Water Code Reference No.	EWMP	Implementation Status	Targeted Flow Path(s)	Benefits	Consequential Effects	Notes (See End of Table)
10608.48.c (5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage	Being Implemented	System Inflows, Operational Spillage, Canal Seepage, Farm Deliveries, Tailwater, Deep Percolation of Applied Water, Drainage Outflows	OID regulating reservoirs allow for improved on-farm delivery steadiness and flexibility, potentially providing a modest reduction in on-farm deliveries due to reduced deep percolation and tailwater. Reservoirs allow operators to reduce operational spillage. Lining and pipeline conversion provide maintenance and operational benefits while also substantially reducing seepage in some areas. OID's ambitious program to spend $80 million on main canal and tunnel improvements and canal and lateral rehabilitation as well as $45 million in pipeline replacement over the 25-year WRP will ensure the long-term reliability of the distribution system. In aggregate, reduced recoverable losses at the farm and district scale result in decreased system inflows. Available water not diverted could allow for service area expansion (annexation) or be available for transfer. Additionally, water quality benefits may occur through reduced tailwater and deep percolation.	Reduced deep percolation and seepage result in reduced beneficial recharge of the underlying groundwater system, potentially contributing to groundwater overdraft. Reduced drainage outflows result in reduced water available for beneficial use by downgradient agricultural or environmental water users.	2
10608.48.c (6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits	Being Implemented	System Inflows, Operational Spillage, Farm Deliveries, Tailwater, Deep Percolation of Applied Water, Drainage Outflows	Changes in ordering and delivery practices, coupled with improvements to the OID distribution system and operation result in increased control for DSOs and improved farm delivery steadiness and flexibility. Farm deliveries could be reduced a modest amount due to reduced deep percolation and tailwater. System improvements result in greater operational efficiency and, potentially, substantial reductions in spillage. In aggregate, reduced recoverable losses at the farm and district scale result in decreased system inflows. Available water not diverted could allow for service area expansion (annexation) or be available for transfer. Additionally, water quality benefits may occur through reduced tailwater and deep percolation.	Reduced deep percolation results in reduced beneficial recharge of the underlying groundwater system, potentially contributing to groundwater overdraft. Reduced drainage outflows result in reduced water available for beneficial use by downgradient agricultural or environmental water users.	2
10608.48.c (7)	Construct and operate supplier spill and tailwater recovery systems	Being Implemented	System Inflows, Drainage Outflows	Current levels of reclamation pumping, tailwater interception, and spillage prevention and planned implementation of approximately $17 million in outflow management and reclamation projects as part of the WRP have and will continue to substantially reduce drainage outflows from OID. As a result, reduced outflows results in decreased system inflows. Available water not diverted could allow for service area expansion (annexation) or be available for transfer. Additionally, water quality benefits may occur through reduced tailwater outflow from OID.	Reduced drainage outflows result in reduced water available for beneficial use by downgradient agricultural or environmental water users. Many of these efficiency improvements require the use of electricity as a component, increasing the need for greater energy demands.	
10608.48.c (8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	Being Implemented	System Inflows, District Groundwater Pumping	Increased conjunctive management benefits OID by improving long-term water supply reliability through the following: 1. Reliance primarily on surface water in wet years to minimize withdrawals from the groundwater system. 2. Strategic operation of OID groundwater wells in dry years to reduce demand for limited surface water supplies and to allow for potential increases in reservoir carryover storage.	Not Significant	2

Water Code Reference No.	EWMP	Implementation Status	Targeted Flow Path(s)	Benefits	Consequential Effects	Notes (See End of Table)
10608.48.c (9)	Automate canal control structures	Being Implemented	System Inflows, Operational Spillage, Farm Deliveries, Tailwater, Deep Percolation of Applied Water, Drainage Outflows	Automation of the OID distribution system results in increased control for DSOs and improved farm delivery steadiness and flexibility. Farm deliveries could be reduced a modest amount due to reduced deep percolation and tailwater. System improvements result in greater operational efficiency and, potentially, substantial reductions in spillage. In aggregate, reduced recoverable losses at the farm and district scale result in decreased system inflows. Available water not diverted could allow for service area expansion (annexation) or be available for transfer. Additionally, water quality benefits may occur through reduced tailwater and deep percolation.	Reduced deep percolation results in reduced beneficial recharge of the underlying groundwater system, potentially contributing to groundwater overdraft. Reduced drainage outflows result in reduced water available for beneficial use by downgradient agricultural or environmental water users.	2
10608.48.c (10)	Facilitate or promote customer pump testing and evaluation	Being Implemented	None	Improved pumping efficiency by OID's customers does not affect the OID water balance but results in decreased energy demand and reduced pumping costs for customers. There are no direct benefits to OID.	Not Significant	
10608.48.c (11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented	Varies	See Comment	See Comment	4
10608.48.c (12)	Provide for the availability of water management services to water users.	Being Implemented	Farm Deliveries, Tailwater, Deep Percolation of Applied Water, System Inflows, Drainage Outflows	Farm water management support by OID could result in limited reductions in on-farm deliveries through reduced tailwater and deep percolation. In aggregate, reduced deliveries result in decreased system inflows and corresponding reductions in drainage outflows. Available water not diverted could allow for service area expansion (annexation) or be available for transfer. Additionally, water quality benefits may occur through reduced tailwater and deep percolation.	Reduced deep percolation results in reduced beneficial recharge of the underlying groundwater system, potentially contributing to groundwater overdraft. Reduced drainage outflows from tailwater result in reduced water available for beneficial use by downgradient agricultural or environmental water users.	2
10608.48.c (13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented	System Inflows	Changes in the policies of agencies that affect OID's flexibility and storage in using its surface water supply could allow for limited improvements in system operation and reductions in system losses. Available water not diverted could allow for service area expansion (annexation) or be available for transfer.	Reduced drainage outflows from operational spillage could result in reduced water available for beneficial use by downgradient agricultural or environmental water users.	
10608.48.c (14)	Evaluate and improve the efficiencies of the supplier's pumps.	Being Implemented	None	Improved pumping efficiency of OID's pumps and prioritizing repairs and replacement based on pump evaluations results in decreased energy demand and reduced pumping costs for OID and increases pump reliability. There are no direct impacts to water balance flow paths.	Not Significant	

Notes:

1. Although delivery measurement does not directly affect any flow paths, it will provide the basis for improved understanding of the overall water balance in the future.
2. OID works to balance tradeoffs between incentivizing on-farm water conservation and maintaining long-term surface water and groundwater reliability for the region.
3. Such lands do not exist in OID. As a result, it is not technically feasible to implement this EWMP.
4. Implementation of the AWMP and WRP by OID's Water Conservation Coordinator/Water Operations Supervisor, General Manager, District Engineer, and other staff as appropriate is the mechanism by which all EWMPs are implemented and targeted benefits are realized.

WUE definitions vary. For purposes of evaluating WUE improvements associated with EWMP implementation by OID, specific WUE improvement categories or objectives, as described by CALFED and DWR (CALFED 2006, DWR 2012b), have been identified that correspond to each EWMP. Potential WUE improvements include reduction of irrecoverable losses, increased local supply, increased local flexibility, increased in-stream flow, improved water quality, and improved energy efficiency. Definitions for each of the WUE improvement categories have been developed and are provided in Table 7-4. Note that the WUE improvement categories are not mutually exclusive in many cases. For example, reductions in irrecoverable losses could be used to increase local supply. The applicability of each EWMP to each WUE improvement category based on OID's water management activities has been identified and is presented in Table 7-5.

Table 7-4. WUE Improvement Categories

Water Use Efficiency Improvement Category	Definition
Reduce Irrecoverable Losses	Reduce losses that cannot be recovered and used by the water supplier or downgradient users (e.g. evaporation and flows to salt sinks).
Increase Local Supply	Reduce losses and/or increase storage locally to increase supply available to meet demands, including both near-term (within an irrigation season) and long-term (over more than one year).
Increase Local Flexibility	Improve the supplier's ability to divert, pump, convey, control, and deliver available water supplies to meet customer demands.
Increase In-Stream Flow	Increase flow in natural waterways to benefit fisheries or meet other environmental objectives.
Improve Water Quality	Increase the quality of targeted water bodies (i.e. streams, lakes, or aquifers).
Improve Energy Efficiency	Increase the efficiency of water supplier or customer pumps.

Table 7-5. Applicability of EWMPs to WUE Improvement Categories.

Water Code Reference No.	EWMP	Implementation Status	Water Use Efficiency Improvement Category					
			Reduce Irrecoverable Losses	Increase Local Supply	Increase Local Flexibility	Increase In-Stream Flow[1]	Improve Water Quality	Improve Energy Efficiency
10608.48. b (1)	Measure the volume of water delivered to customers with sufficient accuracy	Being Implemented	No Direct WUE Improvements					
10608.48. b (2)	Adopt a pricing structure based at least in part on quantity delivered	Being Implemented		✓			✓	
10608.48.c (1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Not Applicable to OID					
10608.48.c (2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.	Being Implemented		✓				
10608.48.c (3)	Facilitate financing of capital improvements for on-farm irrigation systems	Being Implemented		✓			✓	
10608.48.c (4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented		✓			✓	
10608.48.c (5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage	Being Implemented	✓	✓	✓		✓	
10608.48.c (6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits	Being Implemented		✓	✓			
10608.48.c (7)	Construct and operate supplier spill and tailwater recovery systems	Being Implemented		✓			✓	
10608.48.c (8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	Being Implemented		✓				
10608.48.c (9)	Automate canal control structures	Being Implemented		✓	✓		✓	
10608.48.c (10)	Facilitate or promote customer pump testing and evaluation	Being Implemented						✓
10608.48.c (11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented	The activities of the Water Conservation Coordinator and other OID staff to achieve WUE improvements through implementation of the EWMPs are described individually by EWMP.					
10608.48.c (12)	Provide for the availability of water management services to water users.	Being Implemented		✓			✓	
10608.48.c (13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented		✓	✓			
10608.48.c (14)	Evaluate and improve the efficiencies of the supplier's pumps.	Being Implemented						✓

1. Water generated by EWMPs through WUE improvements is stored in New Melones (NM) in a "Conservation Account" set up for SSJID and OID under the 1988 Agreement with the USBR. The account has a total limit of 200,000 acre feet. Water in excess of demand after each irrigation season (ending September 30th of each year) is placed in that account. Withdrawals or access to the account are contingent upon certain parameters, one of which being inflow to NM. When the account is full there can be no more savings and all excess water above the account limit goes into the USBR storage account for NM. At that point, SSJID and OID have no control over how the water is managed. It can be used to meet fish flows, water quality objectives or made available to CVP Contractors.

In order to more explicitly report an estimate of WUE improvements that have occurred since the last AWMP and an estimate of WUE improvements expected to occur five and ten years in the future, OID has estimated the qualitative magnitude (expressed as None, Limited, Modest, or Substantial in order of increasing relative magnitude) for the targeted flow paths associated with each EWMP relative to the applicable WUE improvement categories identified in Table 7-5. Past WUE improvements are estimated relative to no historical implementation and relative to the time of the last plan (adopted in 2005). Future WUE improvements are estimated for five years in the future (2017) relative to 2012 and for ten years in the future (2022) relative to 2012. The result of this evaluation is provided in Table 7-6.

OID will continue to seek out and implement water management actions that meet its overall water management objectives and result in WUE improvements. OID staff regularly attend water management conferences and evaluate technological advances in the context of OID's water management objectives and regional setting. The continuing review of water management within OID, coupled with exploration of innovative opportunities to improve water management will result in future management improvements by OID and additional WUE improvements.

Table 7-6. Evaluation of Relative Magnitude of Past and Future WUE Improvements by EWMP.

Water Code Reference No.	EWMP	Implementation Status	Marginal WUE Improvements[1,2]			
			Past		Future	
			Relative to No Historical Implementation[3]	Since Last AWMP[4]	5 Years in Future[5]	10 Years in Future[5]
10608.48.b (1)	Measure the volume of water delivered to customers with sufficient accuracy	Being Implemented	No Direct WUE Improvements			
10608.48.b (2)	Adopt a pricing structure based at least in part on quantity delivered	Being Implemented	Limited	Limited	Limited to Modest, Depending on Structure	
10608.48.c (1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Not Applicable to OID			
10608.48.c (2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.	Being Implemented	Limited (approx. 2,500 af annually)	None	None to Limited, Depending on Unknown Future Opportunities	
10608.48.c (3)	Facilitate financing of capital improvements for on-farm irrigation systems	Being Implemented	Limited	None	None	None
10608.48.c (4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented	Substantial (Goals B & C)	None	Limited to Modest (Goal A), Depending on Structure	
10608.48.c (5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage	Being Implemented	Substantial (Limited Reduction in Irrecoverable Losses)	Substantial	Substantial (Spillage Reduction from Reservoirs)	Substantial (Spillage Reduction)
10608.48.c (6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits	Being Implemented	Substantial	Substantial	Modest	Substantial
10608.48.c (7)	Construct and operate supplier spill and tailwater recovery systems	Being Implemented	Substantial	Limited	Limited to Substantial, Depending on Funding and Project Prioritization	
10608.48.c (8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	Being Implemented	Substantial	Modest	Limited to Modest, Depending on Funding and Project Prioritization	
10608.48.c (9)	Automate canal control structures	Being Implemented	Substantial	Substantial	Substantial	Substantial
10608.48.c (10)	Facilitate or promote customer pump testing and evaluation	Being Implemented	Modest	Limited	None	None
10608.48.c (11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented	The activities of the Water Conservation Coordinator and other OID staff to achieve WUE improvements through implementation of the EWMPs are described individually by EWMP.			
10608.48.c (12)	Provide for the availability of water management services to water users.	Being Implemented	Modest	None	None	None
10608.48.c (13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented	Substantial	Limited	None to Modest, Depending on Outcomes	
10608.48.c (14)	Evaluate and improve the efficiencies of the supplier's pumps.	Being Implemented	Substantial	Modest	Limited	Limited

1. As noted herein and throughout this analysis, reductions in losses that result in WUE improvements at the farm or district scale do not result in WUE improvements at the basin scale, except in the case of evaporation reduction. All losses to seepage, spillage, tailwater, and deep percolation are recoverable within OID or by downgradient water users within the basin.

2. In most cases, quantitative estimates of improvements are not available. Rather, qualitative estimates are provided as follows, in increasing relative magnitude: None, Limited, Modest, and Substantial.

3. WUE Improvements occurring in recent years relative to if they were not being implemented.

4. WUE Improvements occurring in recent years relative to the level of implementation at time of last AWMP (2005).

5. WUE Improvements expected in 2017 (five years in the future) and 2012 (ten years in the future), relative to level of implementation in recent years.

8. Water Resources Plan Report Card

8.1 Introduction

As discussed previously, the District's Board of Directors initiated the development of the OID Water Resources Plan (WRP) in November of 2004. The WRP represents a comprehensive study of the District's water resources, delivery system, and operations. The overall objective of the WRP is to identify how the District can best protect its water rights while meeting the needs of all its stakeholders and serve the region. The Draft Plan was completed in November 2005 and finalized following the completion of a draft Programmatic Environmental Impact Report (EIR) in January 2007. The WRP provides specific, prioritized recommendations for OID physical and operational improvements as well as a plan to phase the implementation of improvements consistent with available financial resources.

This section of OID's AWMP provides a review of improvement actions identified under the WRP, a summary of actions completed to date, and projections of near- and long-term actions to be completed.

8.2 Summary of WRP Identified Actions and Implementation Schedule

Improvements under the WRP include canal maintenance and rehabilitation, flow control and measurement, groundwater well replacement, pipe replacement, regulating reservoir construction, a Woodward Reservoir intertie (not currently planned), turnout maintenance and replacement, outflow management projects (i.e. spillage and runoff reduction and reuse), reclamation projects, SCADA system expansion, and annexation. The general WRP implementation schedule is shown in Figure 8-1.

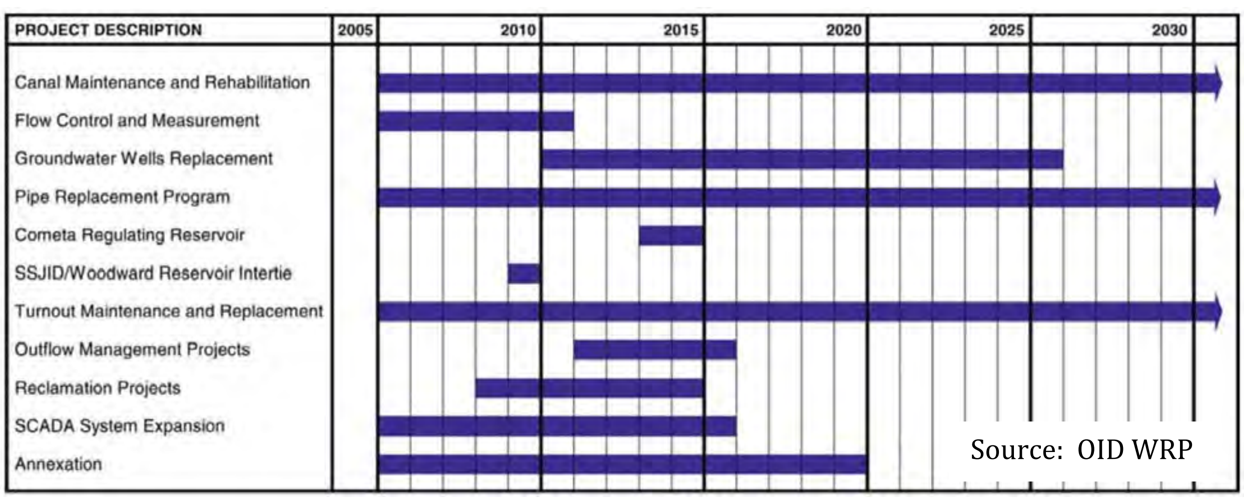

Figure 8-1. OID WRP Implementation Schedule

In addition to the projects listed in Figure 8-1, OID recognized the need for critical improvements to main canals and tunnels to ensure supply reliability by reducing the risk of catastrophic failures that could cut off water supply to large portions of the District. As a result, these improvements have been implemented concurrently with the additional projects identified as part of the WRP.

8.3 WRP Actions Implemented to Date

Since the start of implementation of the WRP in 2006, OID has completed more than 350 individual capital improvement projects. The number of projects implemented by improvement category is provided in Table 8-1, along with the total number of projects implemented each year. Costs associated with these projects total nearly $40 million. Total costs by improvement category are provided in Table 8-2, along with the total cost of projects implemented each year. A summary of WRP documents is provided in Attachment G.

Cumulative implementation costs by improvement category (other than main canal and tunnel improvements) are shown in Figure 8-2. Total annual costs for main canal and tunnel improvements, as compared to other WRP projects, are shown in Figure 8-3. The decrease in implementation cost in 2011 relative to previous years is due to expended bond proceeds and lack of firm long-term water transfers resulting in decreased capital expenditures. OID continues to consider and evaluate opportunities for water transfers, annexations, and other potential revenue sources.

With respect to cost, major projects implemented to date have included main canal and tunnel improvements, which were implemented primarily in 2008 and 2009; construction of the North Side Regulating Reservoir in 2009, installation of flow control and measurement structures, which occurred mainly between 2007 and 2009; and pipeline replacement projects, which occurred primarily in 2006 and 2007.

Table 8-1. OID WRP Number of Projects Initiated by Year, 2006 to 2011

Improvement Category	Number of Projects by Year Started						Total
	2006	2007	2008	2009	2010	2011	
Main Canals and Tunnels Improvement Projects	5	3	3	1	1	2	15
Canal and Lateral Rehabilitation	10	6	2	3	1	0	22
Flow Control and Measurement Structures	14	15	10	15	10	10	74
New and Replacement Groundwater Wells	0	1	1	3	5	2	12
Pipeline Replacement	13	12	4	7	4	5	45
North Side Regulating Reservoir	0	0	0	3	0	0	3
Irrigation Service Turnout Replacement	26	11	22	31	31	17	138
Outflow Management Projects	1	1	1	2	1	1	7
Reclamation Projects	5	5	5	1	4	2	22
Domestic Water Projects	3	0	0	2	0	1	6
Miscellaneous In-System Improvements	0	1	0	0	1	0	2
Total	77	55	48	68	58	40	346

Table 8-2. OID WRP Project Costs by Project Initiation Year, 2006 to 2011

Improvement Category	Total Project Costs by Year Started						Total
	2006	2007	2008	2009	2010	2011	
Main Canals and Tunnels Improvement Projects	$ 578,000	$ 590,000	$ 5,296,000	$ 6,905,000	$ 50,000	$ 199,000	$ 13,618,000
Canal and Lateral Rehabilitation	$ 856,000	$ 275,000	$ 891,000	$ 349,000	$ 3,010,000	$ -	$ 5,381,000
Flow Control and Measurement Structures	$ 477,000	$1,794,000	$ 1,467,000	$ 1,836,000	$ 93,000	$ 297,000	$ 5,964,000
New and Replacement Groundwater Wells	$ -	$ 20,000	$ 28,000	$ 71,000	$ 31,000	$ 262,000	$ 412,000
Pipeline Replacement	$ 2,416,000	$1,643,000	$ 153,000	$ 239,000	$ 359,000	$ 490,000	$ 5,300,000
North Side Regulating Reservoir	$ -	$ -	$ -	$ 6,321,000	$ -	$ -	$ 6,321,000
Irrigation Service Turnout Replacement	$ 137,000	$ 60,000	$ 127,000	$ 144,000	$ 162,000	$ 100,000	$ 730,000
Outflow Management Projects	$ 25,000	$ 63,000	$ 80,000	$ 9,000	$ 9,000	$ 1,000	$ 187,000
Reclamation Projects	$ 16,000	$ 347,000	$ 54,000	$ 970,000	$ 24,000	$ 2,000	$ 1,413,000
Domestic Water Projects	$ 155,000	$ -	$ -	$ 20,000	$ -	$ 4,000	$ 179,000
Miscellaneous In-System Improvements	$ -	$ 14,000	$ -	$ -	$ 7,000	$ -	$ 21,000
Total	$ 4,660,000	$4,806,000	$ 8,096,000	$ 16,864,000	$ 3,745,000	$ 1,355,000	$ 39,526,000

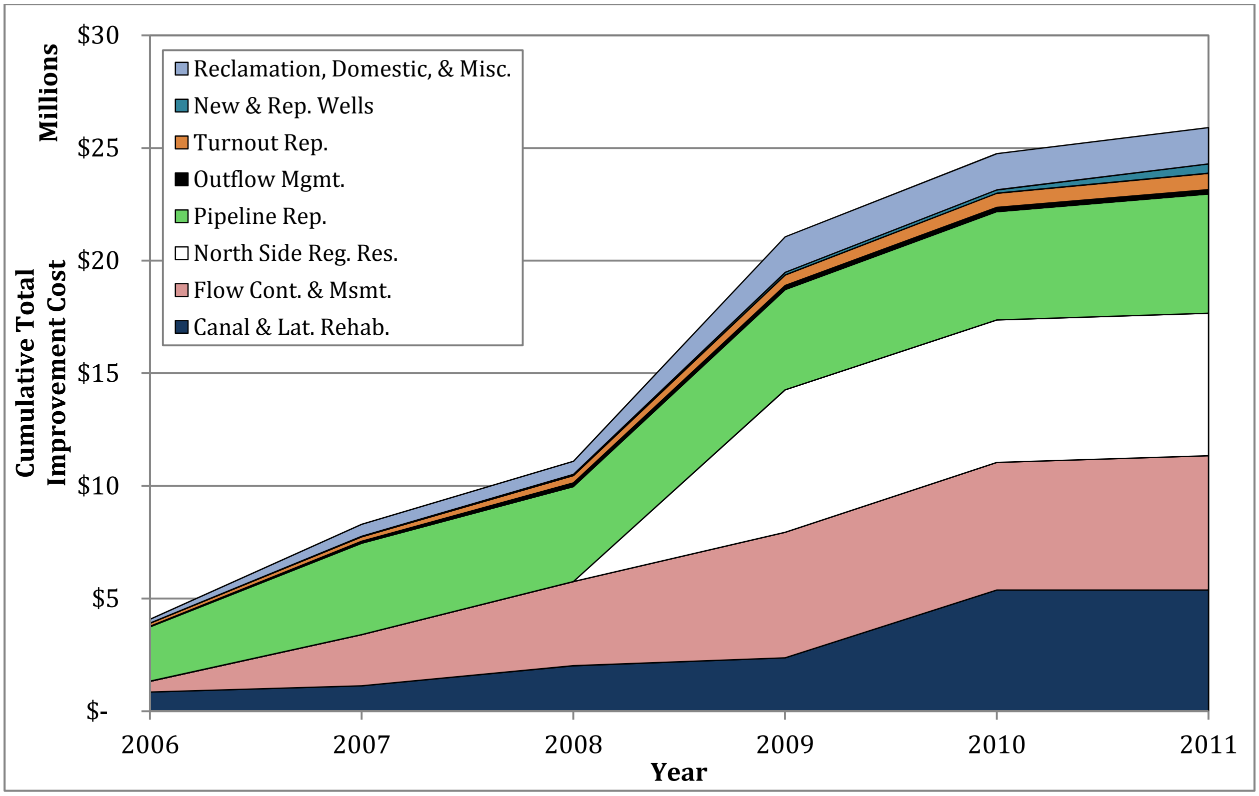

Figure 8-2. OID WRP Cumulative Implementation Costs by Improvement Category

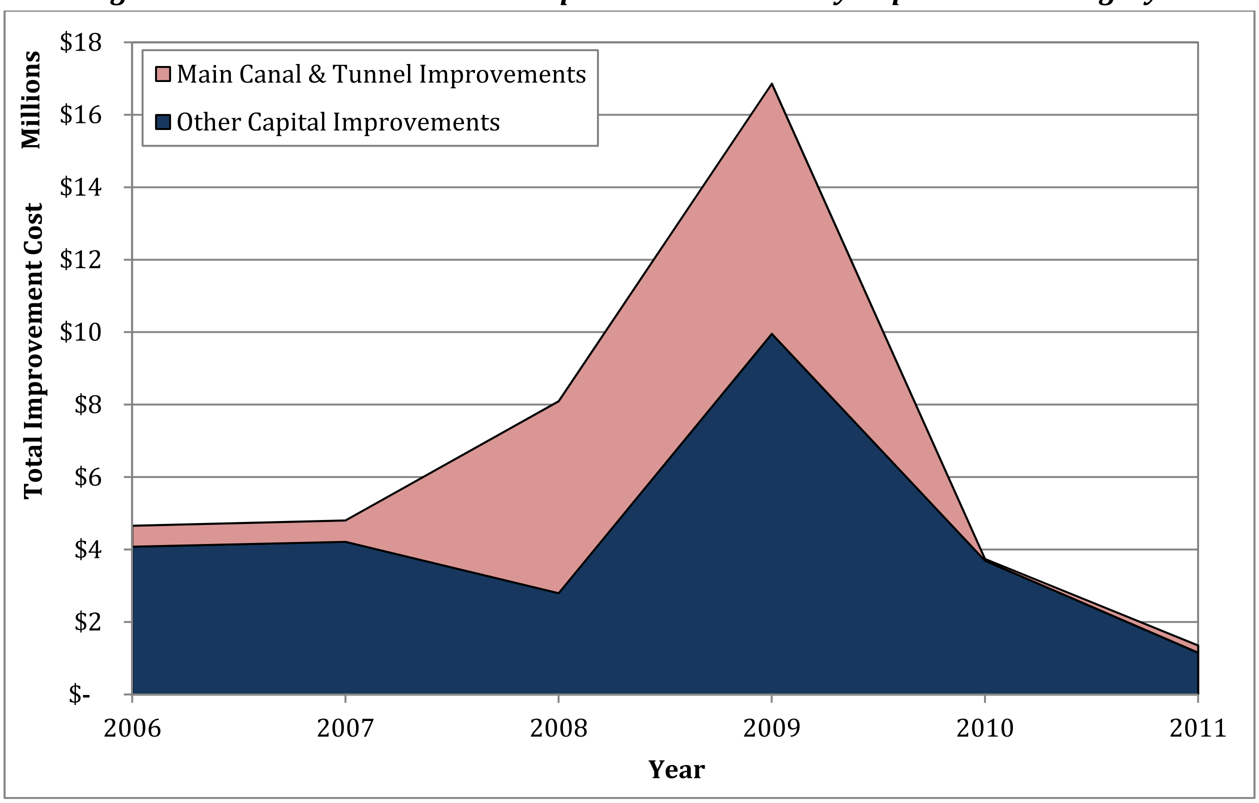

Figure 8-3. OID WRP Annual Implementation for Main Canal and Tunnel Improvements as Compared to Other Capital Improvement Projects

Projects within any given improvement category may include components of other improvement categories. For example, canal and lateral rehabilitation projects and pipeline replacement projects often include turnout replacement. For purposes of this report, project costs as tracked by OID, have not been split for those projects which include components of multiple improvement categories. Additionally, implementation of projects under the WRP has not strictly followed the specific schedule developed as part of the WRP in 2005. As time progresses, OID reprioritizes projects based on current conditions to best meet the needs of the District and its water users. A result of these two considerations is that the specific projects and associated costs implemented since completion of the WRP do not match exactly with the initial schedule and projected costs associated with the WRP; however, cumulative costs and projects completed since completion of the WRP are consistent with projected costs and are focused on the goals of the WRP. These goals include rebuilding and modernizing the OID distribution system to improve water supply reliability while also improving operability and operation of the system. Improved operation is expected to result in reduced losses primarily to spillage. Additionally, the quality of delivery service to customers has improved, including increased delivery steadiness, improved delivery measurement, and increased flexibility in water ordering by and delivery to water customers.

The linkage between projects implemented under the WRP and the EWMPs identified in SBx7-7 and being implemented by OID is described in Table 8-3.

8.4 Near Term Actions Planned for Implementation between 2012 and 2015

As of April 2012, OID initiated 18 additional capital improvement projects in the following improvement categories:

- Flow control and measurement structures
- Irrigation service turnout replacement
- Main canals and tunnels improvement projects
- New and replacement groundwater wells

By 2015, OID plans to implement projects in the following additional categories:

- Canal and lateral rehabilitation
- Domestic water projects
- Outflow management projects
- Pipeline replacement
- Reclamation projects
- Miscellaneous in-system improvements

As has been the case since 2006, future projects will be closely aligned with the WRP, but actual projects implemented in a given year will be based on the evolving specific needs of OID and its customers to maximize cost-effectiveness and to achieve supply reliability and operational benefits within available budgets. As discussed previously, the decrease in implementation cost in 2011 relative to previous years reflects expended bond proceeds and lack of firm long-term water transfers resulting in decreased capital expenditures. As part of the WRP, OID has pursued opportunities for water transfers across multiple potential water markets. These markets include agricultural markets (e.g., existing, adjacent agricultural groundwater users), local and regional areas (e.g., nearby municipal and industrial water users), and metropolitan areas. By evaluating and implementing transfer opportunities across a range of markets, OID is able to meet the financial requirements of implementing the WRP while also maximizing the local beneficial use of available surface water supplies.

Table 8-3. Linkage of SBx7-7 EWMPs to WRP Improvement Categories and Associated Projects

Water Code Reference No.	EWMP	Water Resources Improvement Categories									
		Canal Maintenance and Rehabilitation	Flow Control and Measurement	Groundwater Wells Replacement	Pipe Replacement Program	North Side Regulating Reservoir	Turnout Maintenance and Replacement	Outflow Management Projects	Reclamation Projects	SCADA System Expansion	Annexation
10608.48.b(1)	Delivery measurement accuracy		✓				✓				
10608.48.b(2)	Adopt pricing structure based in part on volume delivered		✓				✓				
10608.48.c(1)	Facilitate Alternative Land Use	Not Technically Feasible									
10608.48.c(2)	Facilitate Use of Available Recycled Water								✓		
10608.48.c(3)	Facilitate financing of capital improvements for on-farm irrigation systems										
10608.48.c(4)	Implement an incentive pricing structure										
10608.48.c(5)	Expand line or pipe distribution systems, and construct regulatory reservoirs	✓	✓		✓	✓				✓	
10608.48.c(6)	Increase flexibility in water ordering by, and delivery to, water customers	✓	✓	✓	✓	✓		✓	✓	✓	
10608.48.c(7)	Construct and operate supplier spill and tailwater recovery systems							✓	✓		
10608.48.c(8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area			✓				✓	✓		✓
10608.48.c(9)	Automate canal control structures		✓			✓		✓		✓	
10608.48.c(10)	Facilitate or promote customer pump testing and evaluation										
10608.48.c(11)	Designate a water conservation coordinator										
10608.48.c(12)	Provide for the availability of water management services to water users										
10608.48.c(13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.										
10608.48.c(14)	Evaluate and improve the efficiencies of the supplier's pumps.			✓							

8.5 Long Term Improvement Actions

OID identifies and plans for specific capital improvement projects on an approximately 5-year planning horizon, allowing for modifications over time as priorities of specific projects shift and financial status changes. OID plans to update the WRP based on experience to date as well as emerging factors such as the conversion to improved delivery measurement and volumetric billing, new water transfers and other financial considerations, and other factors.

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10. Supplemental Information

The following attachments are included as part of this AWMP:

- Attachment A: Rules and Regulations Governing the Operation and Distribution of Irrigation Water within the Oakdale Irrigation District Service Area
- Attachment B: Oakdale Irrigation District Water Measurement Plan
- Attachment C: Out-of-District Surface Irrigation Agreement
- Attachment D: Oakdale Irrigation District Plan to Develop Volumetric Pricing
- Attachment E: Oakdale Irrigation District Surface Water Shortage Policy
- Attachment F: Stanislaus and Tuolumne Rivers Groundwater Basin Association Integrated Regional Groundwater Management Plan
- Attachment G: Oakdale Irrigation District 2005 Water Resources Plan

Attachment A: Rules and Regulations Regarding the Operation and Distribution of Irrigation Water within the Oakdale Irrigation District Service Area

TO VIEW THE COMPLETE RULES AND REGULATIONS,

VISIT:

www.oakdaleirrigation.com/sections/waterops/agwater/rules

Attachment B

Agricultural Water Measurement Corrective Action Plan

According to Requirements of the

California Code of Regulations
Title 23. Waters
Division 2. Department of Water Resources
Chapter 5.1. Water Conservation Act of 2009
Article 2. Agricultural Water Management

Introduction

Oakdale Irrigation District (OID or District) recognizes the need for uniform standards and procedures for measuring and recording field water deliveries in order to: (1) provide the basis for an effective volumetric pricing structure and (2) to generate improved operational records for planning and analysis. Prior to the passage of SBx7-7, a plan to spend approximately $5 million to replace all of the existing turnouts (delivery points) on a 26-year schedule was included in the Water Resources Plan (WRP). OID replaced more than 138 delivery points between 2006 and 2011 totaling more than $730,000 in capital construction costs. However, this does not include turnout replacements that occurred as part of any larger projects (i.e. structure replacement, automation, lateral rehabilitation, etc.). That being said, the funds expended on turnout replacement and the total number of turnouts replaced on an annual basis since the WRP was adopted aligns closer to that proposed.

Since May of 2010, OID has been actively involved as a member of the Agricultural Stakeholder Committee as convened by the Department of Water Resources (DWR) in an effort to assist them with implementation of certain provisions of Senate Bill X7-7 (SBX7-7). The resulting regulation requiring a specified level of delivery measurement accuracy was incorporated into the California Code of Regulations Title 23 Division 2 Chapter 5.1 Article 2 Section 597 (CCR 23 §597, or the Regulation) in July 2012. The information provided in this corrective action plan (plan) is both a summary of the extensive work already completed by OID and a proposed plan for compliance moving forward as an agricultural water supplier providing water to 25,000 irrigated acres or more.

The aforementioned new delivery points were installed and constructed in accordance with the United States Bureau of Reclamation (USBR) guidelines or specific manufacturer recommendations and thus comply with the Regulation. OID is currently inventorying all delivery points for inclusion in an asset management program. The inventory of delivery points on the south side was recently completed and the inventory of the delivery points on the north side is planned for the summer of 2013. OID has also completed a field analysis of a statistically representative sample and found, prior to performing any field testing, that more than one quarter of the samples do not meet the criteria pursuant to §597.3 (a). The Corrective Action Plan (Plan) below documents the actions that OID could potentially take to bring those delivery points, starting with those serving the largest acreage, into compliance and a schedule, budget and finance plan for doing so over the next three years to comply with CCR 23 §597. As implementation of the plan proceeds, OID will regularly evaluate progress and adapt the plan as necessary to better assess the most economical approach to compliance with the accuracy standards while staying consistent with the guidelines of the WRP.

South Side Inventory of Existing Facilities

Procedures

During the summer of 2012, OID initiated a comprehensive inventory of existing delivery points as part of a larger asset management assessment. That work culminated in September 2012 with the complete inventory of the entire south side. The south side of OID encompasses all those lands within OID's current service area (that receive irrigation service) located south of the Stanislaus River, totaling approximately sixty (60) percent of OID's assessed acreage. Data collected for the entirety of the asset management assessment was done so using a Leica CS15 hand held GPS Data Collector with a predefined set of attributes derived by OID Engineering Department Staff. Data collected daily was downloaded at the end of each work day to a series of spreadsheets and organized by facility. As part of the inventory and specific to existing delivery points, staff collected the following data:

1. Spatial location
2. Top of structure elevation
3. Type of delivery point (i.e., meter gate, constant head orifice, etc.)
4. Gate size(s)
5. Condition of delivery point (on a predetermined scale of 1 → 5)
6. Site photo (upstream looking downstream)
7. Measurability assessment

With respect to measurement accuracy, field staff visually inspected and verified that existing gates and stilling wells are properly installed, free of debris and in all cases in good working order. For the south side, delivery points were assigned an attribute of measurable (compliant) based on published accuracy values for a given device type under a defined set of best management practices (BMP's) related to construction, maintenance and operation. Further data processing is being done at this time in an effort to link each delivery point through a unique identifier to a specific parcel. While this data exists in many forms throughout the District it does not reside in one comprehensive data base.

South Side Results

The findings of the inventory to date with respect to delivery point measurement device type are summarized below in Figure 1.

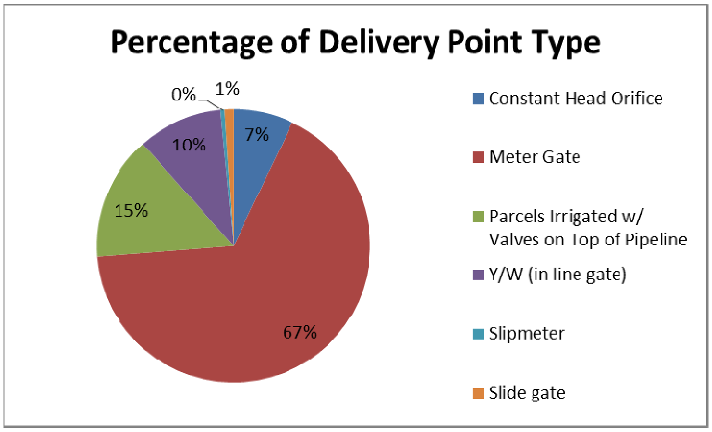

Figure 1. Percentage of Delivery Point Type

While OID intends to complete the delivery point inventory next summer it is reasonable to assume that the percentages of delivery point types found on the south side is applicable District wide.

Statistically Representative Sample Results

In compliance with the Regulation, OID proceeded with development of a randomly selected statistically representative sample in accordance with the Irrigation Training and Research Center's (ITRC) publication entitled, "SBx7 Flow Rate Measurement Compliance for Agricultural Irrigation Districts"[11]. Table 1 shown below provides a summary of the randomly selected statistically representative sample.

Table 1. Randomly Selected Statistically Representative Sample Summary

Randomly Selected Statistically Representative Sample Summary						
Device	Quantity	Non-Compliant w/ Regulation	Acreage Non-Compliant w/ Regulation	Acreage Compliant w/ Regulation	% of sample size non compliant by device and acreage	% of sample size compliant by device and acreage
Meter Gate	63	33	1,650	1,564	29%	28%
CHO	14	0	-	1,796	0%	32%
Valve	5	5	32	-	1%	0%
Weir	1	0	-	363	0%	6%
Pump	2	2	156	-	3%	0%
Other	2	2	62	-	1%	0%
Total =	87	42	1,900	3,722	34%	66%
Total Number of Parcels =						56
Total Random Statistically Representative Sample Acreage =						5622
10% of District Irrigable Acreage =						5581

As summarized above, the analysis yielded the random selection of fifty (56) parcels receiving water from eighty-seven (87) delivery points accounting for at least ten (10) percent of OID's irrigated acreage. Each of the delivery points was then reviewed by field staff with respect to measurement accuracy consistent with the provisions set-forth above and it was determined that

[11] Available from the ITRC at www.itrc.org/reports/sbx7.htm.

forty-five (45) of the eighty-seven (87) delivery points were compliant. The forty-two (42) non-compliant delivery points account for thirty-four (34) percent of the sample size by acreage. Again, assuming that this data is applicable District wide, one can assume that approximately sixty-six (66) percent of water delivered District wide is done so through a measurable delivery point. This is supported by data in the WRP which notes that approximately sixty (60) percent of OID customers own ten (10) acres or fewer and comprise only twelve (12) percent of OID-served land. Further, only four (4) percent of the OID customers own forty (40) acres or more, but these customers represent about sixty (60) percent of OID-served land.

Turnout Standards

OID has assembled a comprehensive set of Standard Construction Details specific to OID's construction and maintenance activities. These Standard Construction Details include details for OID's approved surface water delivery types (turnouts). Each of these delivery types has been designed in accordance with the United States Bureau of Reclamation (USBR) guidelines or specific manufacturer recommendations and approved by OID's District Engineer. For those delivery types constructed in accordance with USBR guidelines the associated measurement accuracies are consistent with those published by USBR (and noted on each specific detail) and in compliance with §597.3(a)(2)(b) of the Regulation. For those delivery methods using off the shelf measurement devices the associated measurement accuracies are consistent with manufacturer specifications and in compliance with §597.3(a)(2)(b) and/or §597.3(a)(2)(a) depending on the civil infrastructure required at the individual delivery point. These details are available from OID and include; (1) STD-1-06, (2) STD-1-07, (3) STD-1-08, (4) STD-1-09, (5) STD-1-12, (6) STD-4-02, (7) STD-4-03 and (8) STD-4-04.

While the above noted standard details are just that, OID has and will continue to explore alternative delivery types compliant with the Regulation. To date, OID has deployed six (6) Rubicon SlipMeters™ as part of the Total Channel Control (TCC) pilot program for flow control and measurement at the delivery point or farm-gate of a single customer. During the 2012/2013 construction season, OID plans to install four (4) new SlipMeters™ in addition to two (2) Rubicon FlumeMeters™. OID continues to invest in and implement cutting edge technology and OID expects that the adoption of the Regulation will result in technological innovations during the next three (3) years that will provide for economically feasible options for compliance with the Regulation that will allow OID to consider accelerating its turnout replacement program.

Delivery Measurement Corrective Action Plan (CCR 23 §597.4(e)(4))

Corrective Action

This section describes OID's corrective action plan over the next three years. Since the recent finalization of the Regulation, OID has developed three options for taking corrective action. As implementation of the preferred option, or options, proceeds, OID will continually assess progress and adapt the plan as necessary to ensure that the corrective actions implemented will achieve compliance with the accuracy standards as directed by the Board of Directors.

Option 1. Replace the turnouts deemed non-compliant by the field inspection in the statistically representative sample starting with the turnouts serving the greatest acreage and then perform the field testing to confirm that all devices have been brought into compliance.

OID's plan for corrective action focuses first on those delivery points identified in the randomly selected statistically representative sample which are known to currently be non-compliant. Within that sample, preference will be given to those delivery points that serve the greatest acreage and thus account for the largest total volume of water delivered.

Assuming the results of the statistically representative sample are applicable District wide, replacing those non-compliant delivery points servicing over one-hundred (100) acres according to OID's comprehensive Standard Construction Details would have the largest overall water management benefits accounting for nearly 80% of the total irrigated acreage. Of the twenty-nine (29) delivery points delivering water to the eighteen (18) parcels noted in Table 2, below, seven (7) are non-compliant. Corrective action will first be taken on these seven (7) turnouts. Following corrective action on those turnouts, approximately 87% of OID's irrigated acreage in the statistically representative sample will be served by either an existing turnout that complies with the Regulation's accuracy requirements through field inspection or because corrective action was taken.

Table 2. Delivery Points and Acreage Served Summary from Statistically Representative Sample

		Total Acres	Number of Delivery Points
Number of Parcels over 100 acres =	18	4399	29
Total Number of Parcels =	56	5622	87
Percentage of Total Acres =	78%		
Percentage of Delivery Points =	33%		

In accordance with the WRP turnout replacement program, OID plans to continue to allocate between approximately $150,000 and $300,000 annually towards replacing turnouts in descending order of acreage served. As technologies and methodologies for water measurement evolve, OID hopes to be able to accelerate the program and complete the program ahead of schedule.

Option 2. Calibrate delivery gates that did not pass inspection.

Following testing of the FlumeMeter™ it is conceivable that calibration of existing non-compliant delivery points and field-testing of the statistically representative sample could be facilitated through temporary installations of the FlumeMeter™ during the irrigation season. The ability to accurately calibrate existing delivery points in accordance with §597.3(a) in an expeditious and economically viable way is paramount.

Option 3. Install downstream stilling wells and other required equipment to bring non-compliant delivery points into compliance.

While this is an option, rehabilitation of existing infrastructure is difficult from a construction perspective, costly and in OID's experience largely yields a less than desirable final product when compared to either Option 1 or 2 as set-forth above.

Schedule

Tentative Schedule for completing delivery measurement corrective action (Assuming Option 1):

1. 2013 – Inventory/field inspection north side
2. 2013 – Take corrective action on a minimum of 15 delivery points (focusing first on those turnouts serving more than 100 acres in the statistically representative sample)
3. 2014 – Take corrective action on a minimum of 15 delivery points
4. 2015 – Take corrective action on a minimum of 15 delivery points and perform field testing.

Budget

The total three year budget for the delivery measurement corrective action plan is $468,000. If additional funds become available as directed by the Board of Directors, compliance activities may be accelerated.

Finance Plan

Annual OID budgets include a lump sum value associated with Capital Projects. As part of that lump sum value, Staff directs expenditures in accordance with the WRP. For 2013, 2014 and 2015, Staff plans to continue to allocate $156,000 annually for the turnout replacement program (corrective action).

Reporting Plan

Detailed Best Management Practices (BMP's) related to data collection, measurement frequency, QA/QC and methodology for determining volumetric deliveries will be included in the 2015 AWMP.

Attachment C: Out of District Surface Irrigation Agreement

AGREEMENT ESTABLISHING TERMS AND CONDITIONS

FOR IRRIGATION OF LANDS, TEN (10) ACRES OR LARGER,

This AGREEMENT made and entered into as of this ___ day of _________________, 20__, by and between __________________ (hereinafter referred to as "Applicant(s)"), and Oakdale Irrigation District, an irrigation district organized and existing under and by virtue of Division Eleven of the Water Code of the State of California (hereinafter referred to as District).

The Applicant(s) has requested that surplus surface irrigation water be made available to APN _________________, located at _______________________, _______, CA for the 20__ irrigation season.

Terms and Conditions

1. This agreement is only applicable to parcels 10 acres or larger in size. See Appendix A for those customers that are grand-fathered into this section.

2. Applicant(s) are the owner of the real property described above.

3. The above described property is within the District's sphere of influence.

4. This Agreement is subject to delivery of surplus surface irrigation water for the above described irrigation season only. The District is under no obligation in the future to subsequent agreements for the irrigation of lands outside the District's boundaries.

5. The determination by the District of the availability of adequate surplus surface irrigation water for out of district lands shall be made by the Board of Directors at the first Board meeting in March.

6. Surplus surface irrigation water deliveries are subject to termination at the sole discretion of the District during the water season.

7. The above described property shall demonstrate that an optimum overall irrigation efficiency of seventy (70) percent or greater will be achieved. The ability to achieve this efficiency will be evaluated by the District's Ag Water Department. The burden is on the Applicant(s) to prove that a seventy (70) percent or better irrigation efficiency will be maintained.

8. The Applicant(s) shall provide a Plan to insure that no agricultural tail water will leave the property. This plan will be evaluated by the District's Ag Water

Department and requires the approval by the District's General Manager.

9. The use of surplus surface irrigation water shall be for agricultural purposes and the Applicant(s) shall demonstrate that the water received is put to reasonable and beneficial uses at all times. Non-beneficial uses include, water for lawns, pasture without livestock, recreational ponds and other practices as determined by the Water Operations Department. Water shall not be used directly or indirectly for any domestic, commercial or industrial purposes.

10. The Applicant(s) shall be required to provide the following at his/her cost;

    a) Installation of a District standard delivery structure for the receipt of water (if not by pump).

    b) Provide a District acceptable measuring device to measure water by gallons per minute and to record by acre-feet delivered. Measuring device to have a factory certification no older than three years.
    c) Pump deliveries are to provide for the pump facility to be located off of District's easement or right of ways.
    d) All private facilities located within District's rights of way shall be so installed under a District Encroachment Permit.

    See Appendix A for those customers that are grand-fathered into this section. These lands may elect to comply with section 10 (a)-(d) in order to be charged the per-acre foot rate established annually by the District's Board of Directors.

11. Applicant(s) have received a copy of and agree to comply with the District's Rules and Regulations for the Distribution of Water in the Oakdale Irrigation District. Non-compliance with any policy or rules of the District could result in forfeiture of surplus surface irrigation water deliveries.

12. The District is under no obligation, either now or in the future, to furnish, construct or maintain any diversion or service structures or facilities on behalf of the above described property.

13. Applicant(s) agree to provide direct vehicle ingress and egress to the District's agents during the term of this agreement.

14. The District makes no representation, guarantee or warranty to Applicant regarding the availability of irrigation water or the quantity, quality, or delivery times of said water.

15. Upon termination of this agreement, the Applicant(s) agrees to pay all costs incurred with retiring those facilities that are no longer needed for water deliveries as determined by the District.

16. Applicant(s) hereby acknowledges that the District sells water as a commodity

only and not as a guaranteed service, and therefore agrees to hold the District, its officers, agents, and employees free and harmless from any liability or damage, including loss of profit or prospective business advantage, which may occur, arise or result from defective water quality, water shortage, fluctuation in flow or interruptions in service.

17. This Agreement shall terminate at the conclusion of the above described irrigation season; notwithstanding any violations of this Agreement as described above.

18. An application for renewal must be submitted annually by the landowner and approved by the District's Board of Directors.

Seasonal Water Charge

The Annual Seasonal Charge for the receipt of surplus irrigation water shall include:

1. A $100 annual filing fee for the processing of the application.
2. Water charges shall be set annually by the Board of Directors prior to the start of the above described irrigation season.

OAKDALE IRRIGATION DISTRICT

____

Steve Knell, P.E.
General Manager/Secretary

OWNER(S)

____

Owner

____

Address:

Telephone:

Attachment D: Oakdale Irrigation District Plan to Develop Volumetric Pricing

OID's pricing structure for water customers with Out-of-District Surface Irrigation Agreements is based on the quantity delivered. Also, the pricing structure for lands currently proposed for annexation into OID and future annexations into OID will be based at least in part on quantity delivered and assessed through volumetric measurement at the delivery point. The pricing structure for these two types of customers complies with the California Water Code Section 10608.48(b)(2).

OID has initiated planning discussions with the Board of Directors (BOD) with the goal of ultimately implementing a pricing structure for In-District customers based at least in part on quantity delivered. The BOD has agreed that they will continue to discuss the issue of adopting a pricing structure at least in part on quantity delivered for all water customers. Two factors compel OID Staff to follow a careful and deliberate planning process. First, Staff recognizes that a 218 process is necessary to change the pricing structure for In-District customers and that constituent support is necessary to successfully complete that process. Second, the new Agricultural Water Measurement Regulation, embodied in California Code of Regulations Title 23 Division 2 Chapter 5.1 Article 2 Section 597 (CCR 23 §597, or the Regulation), effective July 11, 2012, requires OID to measure deliveries with accuracy sufficient to implement a pricing structure based at least in part on quantity delivered.

Volumetric Pricing Implementation Schedule

2013 – Public Outreach

2014 – Initiate 218 Process

2015 – Implement Volumetric Pricing Structure

While many different volumetric pricing options exist, OID has explored the feasibility of implementing a volumetric pricing structure with the following preliminary fundamental objectives:

1. Increased revenue to; (1) provide long-term protection to OID's water rights, (2) address federal, state and local challenges and (3) to rebuild and modernize an out-of-date system to meet changing customer needs.
2. Compliance with SBX7-7.
3. Flexibility for phased implementation.
4. Minimization of implementation costs.
5. Minimization of annual administration costs.

Given the above noted preliminary fundamental objectives, perhaps the most viable option for existing delivery points or future delivery points in compliance with the Regulation is a two (2) part rate structure comprised of a larger fixed base fee to cover operations and maintenance and a smaller variable fee related to the volume of water delivered. Until OID is compliant with the Regulation, growers whose delivery point does not comply with the Regulation could potentially be billed based on a crop allocation similar to that currently used for Out-of-District customers. Given the cost and timeline of compliance as set-forth in the OID Water Measurement Plan (Agricultural Water Management Plan Attachment B), this is one potentially feasible option as an interim solution. A larger fixed base rate would serve to better satisfy OID's financial obligations by providing for a predictable and steady revenue source on an annual basis. A smaller variable rate based on the volume of water delivered would comply with the law while minimizing the opportunity for measurement accuracy disputes with constituents.

Attachment E: Surface Water Shortage Policy

December 2008

Introduction:

When the Oakdale Irrigation District (OID) was formed in 1909 its' specific purpose and charge was and still is as trustee of the surface water rights of the District's constituents. The control and distribution of that water is controlled by the reasonable and beneficial standards under the California Water Code. With respect to those Codes and to the senior water rights of OID, the District is committed to managing this right to the mutual benefit of all lands within the District's service boundaries first and foremost. There will be times however where the quantity of the water right available to the District is insufficient to meet the water demands of the crops grown. In those instances, a policy has been developed to address such shortages.

The following draft Surface Water Shortage Policy is to be used as a guide to the District and its Board during periods of water shortages within the OID service area. Water shortages can occur for a variety of reasons due both to single and multiple events that may include; drought, an early start to the water season, a lack of spring rains, unseasonably high evapotranspiration, contractual obligations, canal failures on either the North or South Main, etc. To prepare for such events the OID has developed the following Surface Water Shortage Policy to address those issues.

Guiding Principles:

The guiding principles presented below are intended to illustrate the basic assumptions that were used to develop the plan. The guiding principles are as follows:

1. The District's obligation under California Water Code is to manage and deliver surface water resources under its charge in a reasonable and beneficial manner.
2. All lands within the District boundaries have an equal right to the availability of surface water, irrespective of crop(s) grown.
3. The District's options for allocating water are limited due to a nominal number of measureable turnouts within the District. Equality, at least for now, can only be determined by the number of rotations in a year provided to each delivery point.
4. District policy is to make surface water available when soil moisture depletion levels reach 2.4 inches.
5. Once the surface water resources of the District, as outlined under the 1988 Stipulation Agreement, are exhausted the District will suspend all water deliveries to its constituents.
6. Upon suspension of water deliveries by the District, landowners may secure other in-district opportunities for water delivery, from landowners with groundwater resources, in order to protect crops.
7. The District will permit intra-district water transfers between and among landowners within the District's service area. The District shall provide administrative and operation services to facilitate these transactions. Such arrangements are limited to groundwater resources within the District's service area only.
8. The District will make available the groundwater resources owned by the District on an at-cost-basis and as approved by the Board of Directors. Landowners may sign up to use a District Deep Well once surface water deliveries have been suspended.

Levels of Surface Water Shortages and OID's Response:

Under the 1988 Stipulation Agreement with the Bureau of Reclamation, OID can expect water shortages when the annual inflow into New Melones is less than 600,000 acre feet. The shortage levels and the subsequent OID actions to be taken for that shortage level are identified below:

1. Level One – The District allocation is between 299,000 acre feet and 270,000 acre feet. As soon as the shortage is known or discovered the District will take any or all of the following actions depending on the shortage:
    a. Suspension of Out of District Agreements
    b. Increase the use of District Deep Wells.
    c. Eliminate all ten (10) day rotations.
    d. Increase rotation intervals to meet 2.4 inch depletion policy (i.e. 16, 18 or 20 day rotations)

2. Level Two – The District allocation is between 269,000 acre feet and 240,000 acre feet. As soon as the shortage is known or discovered the District will take the following actions in the following order:
    a. All of Level One elements
    b. Implement a Rotation Allocation Program – described below
    c. Irrigation water available for agricultural purposes only

3. Level Three – The District allocation is below 240,000 acre feet. As soon as the shortage is known or discovered the District will take the following actions in the following order:
    a. All of Level One and Two elements
    b. Implement a zero discharge policy and issue monetary fines to all violators – described below.

Rotation Allocation Program

The Program would consist of taking the year's net Surface Water Available and dividing it by the *acre-foot per rotation value* (that number shall be determined by the Board based on historical use). The resultant number would be the number of rotations offered to each water user. It would be incumbent upon the water users to determine when they wanted to use their rotations. Under this Program, rotation times would be fixed at pre-water shortage durations. *Example, if the District's net Surface Water Available was 225,000 acre feet and the historical diversion per rotations value was 15,000 acre-feet per rotation, the number of rotations permitted per delivery point would be 15.*

Zero Discharge Policy & Subsequent Fines

Under a Level Three water shortage it will be incumbent upon all lands receiving surface irrigation water to ensure that no water leaves their property. A water user notice will be mailed out after such declaration by the Board of Directors, informing each water user of the discharge restriction. Should a landowner be found in violation of this rule they will be issued a notice and fined accordingly. If the landowner is found to be in violation of the rule a second time they will be fined again and lose all rights to future irrigations for the remainder of the irrigation season.

Fines for such violations shall be set and approved by the Board of Directors annually.

Water Resources & Current Obligations:

Table 1 – Water Resource Inventory & Expenditures

	Normal	Level One	Level Two	Level Three
Stanislaus River Allotment	**600,000 ac-ft**	**599K – 540K**	**539K – 480K**	**479 K – 420K**
OID's Allocation	**300,000 ac-ft**	**299K – 270K**	**269K – 240K**	**239K – 210K**
Stockton East Agreement	-15,000	-15,000	-15,000	-6,250
S.J. River Agreement	-26,000	-26,000	-26,000	-26,000
Knight's Ferry	-1,960	-1,960	-1,960	-1,960
Previous October Usage	-12,500	-12,500	-12,500	-12,500
Surface Water Available	**244,540 ac/ft**	**244K - 215K**	**214K - 185K**	**192K – 163K**
Groundwater	4,000	15,000	15,000	15,000
Reclaimed Water	12,500	6,250	1,000	0
River Water	1,000	1,000	1,000	1,000
Precipitation	14,600	10,000	7,300	0
Sub-Total	**276,000 ac-ft**	**276K – 250K**	**238K – 209K**	**208K – 179K**
Delivery Efficiency (+/-85%)	-42,000	-42,000	-36,000	-31,000
TOTAL (Delivery Available to Turnout)	**234,000 ac-ft**	**234K – 210K**	**202K – 176K**	**177K – 148K**
Shortfall from Normal		24K	58K	86K

Attachment F: Stanislaus and Tuolumne Rivers Groundwater Basin Association Integrated Regional Water Management Plan

TO VIEW THE COMPLETE PLAN,

VISIT:

www.strgba.org

Attachment G: Oakdale Irrigation District 2005 Water Resources Plan

TO VIEW THE COMPLETE PLAN,

VISIT:

www.oidwaterresources.org