

**RECLAMATION DISTRICT  
NO. 108**

**GROUNDWATER MANAGEMENT  
PLAN**

**NOVEMBER 2008**

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RECLAMATION  
DISTRICT

**108**

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### *Manager's Year in Review*

I would consider 2008 to be a year of anticipation for the District. This year groundwater activities were heightened with the reality that many Delta solutions are looking upstream for additional water supply. Additionally, the past two winters were considered critically dry with the 2008 spring being the driest on record. This combined with the increase in proposed legislation related to the State's role in managing local groundwater motivated the Board to move forward on several fronts described below.

The highest priority was to update the District's Groundwater Management Plan. It is considered by the Board as foundational for all other groundwater activities. The plan is designed to provide both the guidance and support for responsible long-term management of the groundwater resource. The Plan was completed and adopted by the Board in November of 2008 after being reviewed by a landowner committee and incorporating their comments. The District also has been actively participating in the effort by Colusa County to develop a groundwater management plan in an effort to ensure the plans are compatible.

The District has two pending grant applications. The first is through Proposition 50 and has been pending for more than a year. It is expected to be funded in the summer of 2009 and includes funding for two production wells to be constructed. The second grant is more of a research project including substantial effort to better define the underground geology. This grant will add another multi-completion monitoring well to the existing 12 within the District. It is the intent to perform the two grant projects jointly to optimize the information gathered.

In the 1970's the District constructed three groundwater production wells as part of a decision to reduce their contract commitment with the Bureau of Reclamation. Two of the three wells are still operated by the District, but only under a "handshake" agreement. During the last half of 2008 the District reached agreement to formalize a well easement with each of these two landowners.

An essential part of the Board's groundwater efforts were steered by the two landowner meetings that were held in 2008. The meetings focused on obtaining feedback from landowners on how they would like to see groundwater developed and managed within the District. While opinions certainly varied, both meetings were very constructive in keeping communications open and helping to form a path forward.

Thanks for the opportunity to share my thoughts on 2008. Please stop by the office or give me a call if you would like an update or would like to share some of your thoughts.

Sincerely,

Lewis Bair  
General Manager



## 1. INTRODUCTION

### 1.1. Purpose of Groundwater Management Plan

Reclamation District No. 108 (RD 108 or District) has prepared this Groundwater Management Plan (GMP) to set forth specific objectives for groundwater within the District, along with actions that will be taken to meet these objectives. The purpose of this effort is to achieve the District's groundwater management goal:

*To maintain a sustainable, high-quality groundwater resource for use by the District and its landowners in supplementing water supplies and in serving the best interests of the District.*

This GMP is intended to manage the area within RD 108.

### 1.2. History of the District

RD 108 was formed in 1870 under the general Reclamation District Law of 1868 for the purpose of constructing levees to provide flood protection to over 100,000 acres of farmland along the west side of the Sacramento River from north of Colusa to Knights Landing. In early 1917, the District began constructing major irrigation distribution system facilities for delivery of water from the Sacramento River to a "service area" of approximately 48,000 acres.

The District's service area is located within southern Colusa County and northern Yolo County along the west side of the Sacramento River, between the towns of Grimes and Knights Landing. The service area is surrounded on three sides by flood control levees: on the east by the westerly levee of the Sacramento River, on the west and southwest by the Colusa Basin Drain (commonly referred to as the "Back Levee"), and on the southeast by the northerly levee of Reclamation District No. 787 (Figure 1).

In 1964, the District entered into a water rights settlement contract with the U.S. Bureau of Reclamation (Bureau) that provided for supplemental water during the summer months from the Central Valley Project. Except during critically dry years, as defined in the contract, the District's surface water supply from the Sacramento River has been able to meet the irrigation demands of the 48,000-acre service area and, in certain years, the District has been able to help its neighbors with authorized water transfers.

Because of the District's established rights to surface water and its contract with the Bureau, Sacramento River water has supplied nearly all of the water needs of District lands. Over time there has been only limited development of the groundwater supply for irrigation, mostly along the Sacramento River corridor. Residents throughout the District have private

wells and use groundwater for domestic supply, but this represents a very small percentage of overall water use.

### **1.3. Background of RD 108 Groundwater Management**

Pursuant to AB 3030 (California Water Code Section 10750 et. seq.), the District initially adopted a Groundwater Management Plan (GMP) on February 6, 1995. The 1995 GMP focused on compiling and evaluating available data on groundwater in order to assess the potential of the underground water supply and develop a plan for its management and use.

In 2002, the State Legislature passed SB 1938, which amended California Water Code Section 10750 et. seq. to require that GMPs adopted by local agencies include certain components to be eligible for public funds administered by the California Department of Water Resources (DWR). In 2006, RD 108 revised its GMP to meet the requirements established by SB 1938. The amended GMP was adopted on November 14, 2006.

In 2008 the GMP was revised and updated to expand the discussion of GMP implementation, groundwater monitoring, and RD 108's ongoing participation in regional groundwater management.

### **1.4. Participation in Regional Groundwater Management Plans and Activities**

In addition to its own GMP, RD 108 is an active participant in several other regional groundwater management activities.

#### **1.4.1. Sacramento Valley Integrated Regional Water Management Plan (IRWMP)**

RD 108 is very involved in the Sacramento Valley IRWMP Process. RD 108 is a member of the Northern California Water Agency (NCWA) and a partner in the Sacramento Valley Water Management Agreement of April 2001. In December 2002, along with other water districts, RD 108 executed the *“Short-Term Agreement to Guide Implementation of Short-Term Water Management Actions to Meet Local Water Supply Needs and to Make Water Available to the SWP and CVP to Assist in Meeting the Requirements of the 1995 Water Quality Control Plan and to Resolve Phase 8 Issues.”*

NCWA is the administrator for the Northern California Joint Exercise of Powers (JEP), a joint exercise of powers among 17 public entities in Northern California that includes RD 108. As administrator of the JEP, NCWA is coordinating the preparation of the Sacramento Valley IRWMP on behalf of the Sacramento Valley IRWMP Region. The RD 108 Board of Trustees adopted a resolution that authorizes NCWA to act on its behalf with regard to several IRWMP elements.

1.4.2. Colusa County Groundwater Management Plan

Colusa County is currently in the process of developing a GMP, and RD 108 has been involved in this effort by participating in Plan Advisory Committee meetings and other meetings and discussions with Colusa County relating to this effort. RD 108 maintains authority to implement its GMP within the Colusa County portion of the District, but intends that its GMP will be consistent with and implemented in coordination with the Colusa County GMP.

1.4.3. Yolo County Integrated Regional Water Management Plan

RD 108 did not become a member of the Water Resources Association of Yolo County, which prepared the IRWMP, because of financial requirements of participation that were prohibitive. Nevertheless, RD 108 has participated in the IRWMP process by participating in stakeholder meetings. RD 108 also cooperates with Yolo County Flood Control and Water Conservation District (YCFCWCD) by providing YCFCWCD with RD 108 well data.

**1.5. Groundwater Management Plan Components**

The RD 108 GMP has been prepared to be consistent with required, recommended, and voluntary components of Groundwater Management Plans, as set forth in the California Water Code and by DWR in Bulletin 118.

1.5.1. California Water Code Required Components

Section 10750 et seq. of the California Water Code, as amended by SB 1938, requires GMPs to include six mandatory components to be eligible for the award of funds administered by DWR for the construction of groundwater projects or groundwater quality projects. These components are listed below.

<i>Description</i>	<i>GMP Section</i>
Make available to the public a written statement describing the manner in which interested parties may participate in developing the groundwater management plan.	1.6
Include Basin Management Objectives (BMOs), including components relating to the monitoring and management of groundwater levels, groundwater quality degradation, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping.	3.2

<i>Description</i>	<i>GMP Section</i>
Prepare a plan to involve other agencies that enables RD 108 to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin.	3.2, 4.2
Prepare a map showing the groundwater basin, RD 108's area, and the boundaries of other local agencies within the groundwater basin.	Figures 1 and 2
Adopt monitoring protocols designed to detect changes in groundwater levels, groundwater quality degradation, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping.	4.1
For areas outside a groundwater basin, use geologic and hydrologic principles appropriate to those areas. [ <i>This is not applicable for RD 108 because the entire District lies within a defined groundwater basin.</i> ]	N/A

1.5.2. DWR Bulletin 118 Recommended Components

DWR's Bulletin 118 recommends other components that may voluntarily be included in a GMP. These are listed below.

<i>Description</i>	<i>GMP Section</i>
Establish an advisory committee of stakeholders to help guide the development and implementation of the plan and provide a forum for resolution of controversial issues.	4.2.1
Describe the area to be managed under the GMP.	1.1
Describe how meeting each BMO will contribute to a more reliable long-term groundwater supply, and describe management actions to achieve each BMO.	3.2, 4.2
Describe GMP monitoring program.	4.1
Describe integrated water management planning efforts.	1.4

<i>Description</i>	<i>GMP Section</i>
Periodically report groundwater basin conditions and groundwater management activities.	4.2
Evaluate GMP periodically.	1.3, 4.2

1.5.3. California Water Code Voluntary Components

CWC Section 10753.8 lists twelve issues and components of groundwater management that may voluntarily be included in a GMP. Not all of these are relevant or applicable to RD 108. The applicable issues and components are listed below.

<i>Applicable Issue or Component</i>	<i>GMP Section</i>
The control of saline water intrusion.	3.2
Identification and management of wellhead protection areas and recharge areas.	3.2
Monitoring of groundwater levels and storage.	4.1
Facilitating conjunctive use operations.	2.2.3, 3.2
The construction and operation of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.	2.2.3
The development of relationships with state and federal regulatory agencies.	3.2

The issue of “*mitigation of conditions of overdraft*” is not directly applicable to RD 108, because overdraft has not historically been a problem within RD 108. However, in the Zamora area south of RD 108, inelastic land subsidence (which is an indication of overdraft) has been a noted problem. More recently, there has been a loss of canal freeboard in the southern portion of the District, which is likely indicative of inelastic land subsidence in that area. It is unclear how this loss of freeboard is related to groundwater pumping within or outside of RD 108. The avoidance of groundwater overdraft is a stated BMO in Section 3.2.3, and Section 4.2.3 describes the actions the District will take to avoid groundwater overdraft.

The following issues and concerns are not relevant or applicable to RD 108.

1. *Regulation of the migration of contaminated groundwater.* Contamination of groundwater is not known to be a problem within RD 108, although the BMO of “Avoiding Water Quality Degradation” does address some issues related to contamination.
2. *The administration of a well abandonment and well destruction program.* RD 108 does not administer such a program. RD 108 is located in Yolo and Colusa Counties, both of which have ordinances that cover well abandonment and destruction within the respective Counties, including within RD 108.
3. *Replenishment of groundwater extracted by water producers.* Historically, the lands within RD 108 have been supplied almost entirely by surface water, so groundwater extraction has not been significant. Further, groundwater is very close to the ground surface and in some cases flows artesian within RD 108, limiting the ability to conduct groundwater replenishment activities.
4. *The review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination.* Land use within RD 108 is largely agricultural and no major changes in land use are anticipated. As such, this has not been issue; however, it is addressed as part of the General Plan process by Yolo and Colusa Counties.

#### **1.6. Public Involvement**

RD 108’s 2006 amended GMP was developed through a public process that included the formation of a Groundwater Task Force to provide direction and guidance to the updating and amending of the of the GMP. The Groundwater Task Force includes RD 108 landowners and landowners/stakeholders outside of RD 108. The Groundwater Task Force met three times in 2006: February 8, March 29, and April 6. The group directed and reviewed the preparation of the amended GMP. A public meeting was held on September 28, 2006 for all stakeholders. No opposition to the GMP was voiced at this meeting, and the GMP is generally supported by basin stakeholders. The adoption of the amended GMP was announced at an official public hearing prior to adoption.

The 2008 update of RD 108’s GMP was completed through a public process that included a Groundwater Task Force meeting to review the draft updates and provide input prior to finalizing the draft and forwarding it to the RD 108 Board for adoption.

## 2. WATER RESOURCES SETTING

### 2.1. Surface Water Supplies

#### 2.1.1. Topography

RD 108 is located in the Sacramento Valley, which is bounded on the northwest by the Klamath Mountains, on the west by the Coast Ranges, on the east by the Cascade Range and the Sierra Nevada, and on the south by the Sacramento-San Joaquin Delta.

The District is located in the relatively flat floor of the Sacramento Valley, with elevations ranging from approximately 18 to 40 feet above mean sea level.

#### 2.1.2. Climate

The Sacramento Valley is characterized by hot, dry summers and cool, wet winters. The total annual precipitation within the District averages between 15 and 20 inches. Most of the precipitation in the Valley occurs during November through April. During the period between 1961 and 1999, the average annual rainfall in the area of the Valley from Sacramento to Red Bluff was 19.52 inches, and ranged from a low of 15.82 inches to a high of 22.62 inches. Snowfall in the Sacramento Valley is rare, with the highest annual average of 4.8 inches measured in Redding. Winds in the Valley blow predominantly from the north and south because of the mountainous regions' alignment bordering the Valley.

#### 2.1.3. Surface Water Rights and Entitlements

RD 108 obtains its primary water supply from the Sacramento River under its riparian water rights, settlement contract and licenses for appropriation of surface waters. This water supply is supplemented from time to time by groundwater, using the District's two current production wells.

RD 108 began construction of major irrigation distribution system facilities in 1917 for delivery of water from the Sacramento River to approximately 48,000 acres. RD 108 entered into a water right settlement agreement with the U.S. Bureau of Reclamation in 1964, quantifying the amount of water RD 108 could divert from the Sacramento River. The resulting negotiated agreement recognized RD 108's annual entitlement of Base Supply of 199,000 acre-feet/year of flows from the Sacramento River and initially provided for a 54,500 acre-foot allocation of Project Water. In 1974, the District reduced its Project Water allocation to 33,000 acre-feet. In February 2005, the District and Bureau entered into a renewal contract with a term of 40 years. The renewal contract included a total contract entitlement of 232,000 acre-feet per year.

The District’s surface water rights, diversion dates and entitlements are shown in below.

<i>Source</i>	<i>Application (Priority Date)</i>	<i>Permit (Date)</i>	<i>License (Date)</i>	<i>Diversion Season</i>	<i>Maximum Diversion Rate (cfs)</i>
Sacramento River	A000576 (1/25/17)	000315 (7/24/17)	003065 (2/24/50)	February 1 – October 31	180
Sacramento River	A000763 (8/27/17)	000388 (1/16/18)	003066 (2/24/50)	February 1 – October 31	500
Sacramento River	A001589 (12/26/19)	001885 (11/22/24)	003067 (2/24/50)	May 1 – October 1	255.25
RD 108 Back Levee Borrow Pit (Colusa Basin Drain)	A011899 (5/26/47)	008251	(12/20/50)	April 1 – October 1	75

In addition, on May 13, 2003 the District applied for a permit from the State Water Resources Control Board to divert up to 36,000 acre-feet of water from the Sacramento River at the Wilkins Slough Pumping Plant during the winter months, from November 1 to February 1. The purpose of the permit is to supplement existing riparian rights for rice straw decomposition.

2.1.4. Surface Water Quality

The reach of the Sacramento River from Red Bluff to the Delta is of generally good quality. The DWR Northern and Central Districts maintain a network of water quality monitoring and surface water sampling stations throughout the Sacramento Valley. The agency operates electronic continuous recorders for field monitoring of water quality parameters; periodically, agency personnel conduct field analyses and collect water quality samples for laboratory analysis from rivers, lakes, reservoirs, and certain drains within the Sacramento Valley. The agency also conducts studies to determine the physical, chemical, and biological characteristics of streams, lakes, and reservoirs in the districts. The studies, in part, are conducted to evaluate factors contributing to enrichment (eutrophication), factors affecting drinking water quality, and the influence of watershed development. DWR also maintains a database of current and historical water quality data.

### 2.1.5. Surface Water Distribution System

RD 108 owns and operates an irrigation system that includes 9 pumping plants, 5 of which are located along the Sacramento River. Irrigation canals totaling about 120 miles convey the river water to farms within the District's service area. The District also owns and operates a drainage system used for removing drainage water and winter storm runoff. Because the District has no natural drainage outlet, excess drainage water and rainfall runoff, which accumulate in over 300 miles of District drains, are channeled to the Rough and Ready Pumping Plant (850 cfs capacity) near the southeast corner of the District where the water is pumped into the Sacramento River for use downstream. The Riggs Pumping Plant on the northwest side of the District, adjacent to the Colusa Basin Drain, is a multi-purpose facility. Drainage of water from the north can be discharged into the Colusa Basin Drain or pumped into the irrigation canal system for reuse. The plant is also used to divert water from the Colusa Basin Drain for irrigation of District lands as a supplemental supply.

## 2.2. Groundwater Supplies

### 2.2.1. Groundwater Basin

RD 108 is located in the Colusa Subbasin of the Sacramento Valley Groundwater Basin (Figure 2). The Sacramento Valley Groundwater Basin covers an area of approximately 4,900 square miles, and extends from Red Bluff to the Sacramento-San Joaquin Delta. It is bordered by the Coast Ranges to the west, and the Cascade Range and Sierra Nevada Mountains to the east (DWR, 2000). The Sacramento Valley Groundwater Basin includes all of Sutter County and parts of Yuba, Tehama, Glenn, Butte, Colusa, Solano, Yolo and Sacramento Counties.

The water-bearing formations (aquifers) within RD 108 include, from shallowest to deepest: stream channel deposits, basin deposits, the Modesto and Riverbank Formations, and the Tehama Formation. The Tehama Formation is the major aquifer within RD 108.

### 2.2.2. Groundwater Conditions

Groundwater conditions within RD 108 are good in some respects and average in others. Spring groundwater levels have remained stable over the period of record, indicating that pumping and recharge are balanced on an ongoing basis; however, seasonal (spring-fall) fluctuations can be large. Groundwater quality generally meets agricultural goals except for some cases of high salt concentrations; high concentrations of arsenic and manganese (exceeding public drinking water standards) are also found.

Most of the monitoring wells within the District were constructed in the late 1990's, so long-term groundwater level records are limited. Data from DWR monitoring well 13N/01E-11A1 (Figures 3 and 4) shows that groundwater levels have remained essentially constant from 1953 to present. The more recently-constructed monitoring wells show that spring groundwater levels have stayed within a 5- to 8-foot range since the wells were constructed. Seasonal (spring-fall) fluctuations range from 5 to 70 feet, depending on the well depth and location.

Several standards are used to evaluate water quality, including those established by the Regional Water Quality Control Board, California Department of Public Health, and US Environmental Protection Agency. For the purposes of evaluating groundwater quality within RD 108, it is useful to consider the public drinking water quality standards established by the California Department of Public Health (DPH, formerly California Department of Health Services or DHS), and agricultural goals established by the United Nations Food and Agriculture Organization (FAO). It is important to recognize that non-public wells are not required to meet public drinking water standards, but they still provide a point of reference. The District's three production wells were sampled in 2003<sup>1</sup> and analyzed for field parameters, minerals, minor elements, and nutrients. Water from 13N/01E-3J1 (#1) exceeded the agricultural goal for sodium and the public drinking water standards for arsenic, manganese, and nickel. Water from 14N/01W-27M1 (#2) met all standards. Water from 13N/01E-8A1 (#4) exceeded the agricultural goal and public drinking water standard for specific conductance and total dissolved solids, and the agricultural goal for chloride; the well also exceeded the public drinking water standards for arsenic and manganese.

RD 108 has also monitored specific conductance over time in its production wells during the pumping season. Data from the 2003, 2007, and 2008 seasons (Figure 5) show that specific conductance in water pumped from 13N/01E-3J1 (#1) and 14N/01W-27M1 (#2) has remained fairly stable over time. Water from 13N/01E-8A1 (#4) showed significant declines in specific conductance at the beginning of the pumping season, with values then stabilizing.

Data on inelastic land subsidence within RD 108 is limited. Inelastic land subsidence has historically been a problem in the Zamora area, south of RD 108. Measurements at DWR's Zamora extensometer, located approximately 2 miles south of the District's southern boundary, began in 1992 and show a seasonal elastic fluctuation in land surface elevation of approximately 0.2 feet. The Zamora extensometer also shows an overall decline in land surface elevation of approximately 0.4 feet from 1994 to 2007,

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<sup>1</sup> Well 14N/01W-27M1 (#2) is no longer a District production well.

which may represent inelastic subsidence. Within RD 108, there has been a loss of canal freeboard in the southern portion of the District, which is likely indicative of inelastic land subsidence in that area. It is unclear how this loss of freeboard is related to groundwater pumping within or outside of RD 108.

### 2.2.3. Conjunctive Use and Groundwater Transfers

In 1995, the same year it adopted its first GMP, the District was contacted by representatives of DWR regarding participation in a conjunctive use study that focused on evaluating the groundwater resources of southern Colusa County and northern Yolo County. The intent of this study was to develop sufficient information to provide a reliable basis for local agencies to formulate water resource management plans integrating surface and groundwater, subject to locally adopted groundwater management plans.

Since late 1995 Reclamation District No. 108 has been working with DWR to investigate the groundwater resources within the District. Over the past 10 years, a substantial amount of work has been completed under the District's Groundwater Management Program through DWR's investigations of the Basin, including the installation of 12 multiple-completion groundwater monitoring wells (Figure 3). DWR has monitored these wells since 2001, and continues its efforts as part of the Lower Colusa Basin groundwater studies.

In addition to the information and data being collected and analyzed by DWR, the District is directly involved in a major basin-wide water management planning effort on the Sacramento River, the Basin-Wide Management Plan (BWMP), which includes the potential for integration of surface water from the River with groundwater supplies. The Bureau and DWR are participants in this planning effort.

In the early 1960's, the District installed three irrigation wells within its northern area. Only two of the wells – 13N/01E-3J1 (#1) and 13N/01E-8A1 (#4) – are still used; 14N/01W-27M1 (#2) is no longer a District production well. The District's wells have been used as an emergency water source and, since the early 1990's, as a contributing supply for the California drought water bank, and as an in-lieu supply for other water transfers.

During 2003, Reclamation District No. 108 participated in a water transfer program with Metropolitan Water District of Southern California (MWDSC) with an agreement to transfer 5,000 acre-feet of groundwater. The District made water available for the MWDSC Colorado River Contingency Plan from the then three District-owned irrigation wells. As part of the water transfer, the District and DWR agreed to work cooperatively, with DWR assisting with groundwater monitoring activities. DWR

began taking groundwater measurements during March and April of 2003 in order to establish background water level data prior to the production wells being turned on. The District production wells 13N/01E-3J1 (#1), 14N/01W-27M1 (#2), and 13N/01E-8A1 (#4) were turned on 07/01/03, 07/02/03 and 07/03/03, respectively. Groundwater levels were monitored at all the wells during extraction and recovery. Aquifer parameters were determined by analyzing groundwater level data that was collected at the production wells and the neighboring third party wells.

Water quality samples were also collected and analyzed from the three District production wells after they had been pumping for about seven weeks. Groundwater samples were analyzed for minerals and field parameters, minor elements and nutrients.

### 3. ELEMENTS OF MANAGEMENT PLAN

#### 3.1. Groundwater Management Goal

RD 108's groundwater management goal is:

*To maintain a sustainable, high-quality groundwater resource for use by the District and its landowners in supplementing water supplies and in serving the best interests of the District.*

#### 3.2. Basin Management Objectives

Groundwater management is intended to contribute to a more reliable long-term groundwater supply. An understanding of the unique hydrologic and geologic characteristics of the groundwater basin within the District and how those characteristics relate to conditions within the greater Colusa Subbasin is key to the management of the resource. The following Basin Management Objectives (BMOs) describe how the District seeks to manage groundwater to achieve its groundwater management goal.

##### 3.2.1. Involve District Landowners and Outside Stakeholders

Groundwater management efforts by the District could have an impact, both beneficially and adversely, on landowners within the District and those landowners and agencies outside the District that have a stake in the management of the Colusa Subbasin.

To involve these landowners and stakeholders, the District has established a Groundwater Task Force. The Groundwater Task Force is an advisory body that is open to interested parties. The Groundwater Task Force will meet publicly at least once per year to discuss groundwater conditions and activities and to provide input related to the District's groundwater management efforts. The Groundwater Task Force will assist in defining specific projects, and will also be charged with suggesting project priorities and making recommendations on both short and long-term projects.

In addition to the Groundwater Task Force, the District's General Manager, under direction from the Board, has established relationships with both Yolo and Colusa Counties through their groundwater commissions and advisory committees. The General Manager has also established relationships with state and federal agencies. The General Manager will continue to represent the District with respect to these counties and agencies, and will maintain involvement with other regional groundwater and water management projects.

This BMO will contribute to a more reliable long-term groundwater supply by coordinating groundwater management efforts within the District with other efforts in the Colusa Subbasin and Sacramento Valley Groundwater Basin. These coordinated

efforts will have a higher likelihood of success in maintaining a reliable long-term groundwater supply than would individual isolated efforts.

### 3.2.2. Monitor and Study Groundwater

The objective of groundwater monitoring and studies is to develop a complete and accurate picture of the groundwater resource and groundwater conditions in that portion of the basin that underlies the District.

This BMO will contribute to a more reliable long-term groundwater supply by providing the information needed to base groundwater management decisions on geologic and hydrogeologic principles that are appropriate for the characteristics of the resource and the changing conditions of the resource. This will make groundwater management actions more effective in maintaining a reliable long-term groundwater supply.

### 3.2.3. Avoid Groundwater Overdraft

In Bulletin 118, DWR defines “groundwater overdraft” as:

“The condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions.”

It is not currently possible to directly measure all water pumped from and recharged into the Sacramento Valley Groundwater Basin. For this reason, measurements of water levels and inelastic land subsidence are used to evaluate the relationship between pumping and recharge on an ongoing basis.

To avoid groundwater overdraft, RD 108 will seek to accomplish the following:

- Avoid ongoing declines in groundwater levels during water year types identified by DWR to be “above normal” or “wet” for the Sacramento Valley.
- Avoid decreases in water supply availability.
- Avoid inelastic land subsidence.
- Avoid changes in surface flow and surface water quality that directly affect groundwater levels or are caused by groundwater pumping.

RD 108 is fortunate to have surface water rights and entitlements that allow it to conjunctively use both surface water and groundwater. Balancing surface and groundwater uses through periods of drought and when excess surface water exists is

the District's key strategy for protecting and managing the groundwater resource, and for avoiding groundwater overdraft.

This BMO will directly contribute to a more reliable long-term groundwater supply by avoiding groundwater overdraft, since overdraft reduces the long-term reliability of the groundwater supply.

#### 3.2.4. Avoid Water Quality Degradation

The objective of avoiding water quality degradation is to ensure that groundwater remains suitable for domestic and irrigation uses.

Saline water intrusion from the Sacramento-San Joaquin Delta has not been encountered in RD 108; however, there is a potential in RD 108 for increases in salinity due to salt-loading, or up-coning of poorer quality water from marine sediments, or from shallow aquifers with higher salinity.

To avoid water quality degradation, RD 108 will seek to accomplish the following:

- Avoid ongoing increases in specific conductance in groundwater.
- Avoid changes in surface flow and surface water quality that directly affect groundwater quality.
- Avoid use of high-salinity aquifers.
- Avoid construction of new wells that interconnect aquifers with significantly different water quality.
- Avoid activities in the immediate vicinity of a wellhead that could cause contamination of the well.

This BMO will directly contribute to a more reliable long-term groundwater supply by avoiding water quality degradation, since degradation of water quality reduces the long-term reliability of the groundwater supply.

#### 4. PLAN IMPLEMENTATION

Since 2000, RD 108 has made significant progress in implementing its GMP. Implementation is separated into the District's Groundwater Monitoring Program, and its Action Plan.

##### 4.1. Groundwater Monitoring Program

The objectives of the District's groundwater monitoring program are to provide the data necessary to:

- Develop a complete and accurate picture of groundwater conditions.
- Track changes in groundwater conditions for the purpose of meeting the BMOs.

The monitoring program is divided into monitoring locations and protocols for groundwater levels, water quality, inelastic land subsidence, and surface water.

##### 4.1.1. Groundwater Level Monitoring

DWR currently measures water levels in 13 wells within RD 108, 12 of which are dedicated multiple-completion monitoring wells. DWR has established protocol that it follows when making the measurements. These monitoring wells are summarized in Table 1 and shown in Figure 3. Five of these monitoring wells have been selected as "key" monitoring wells that the District will use to evaluate groundwater conditions annually. These wells were selected for their locations, spread across the District, and for their period of record. The "key" wells are: 12N/1E-7N1/2/3, 12N/1E-26A1/2/3, 13N/1E-11A1, 13N/1E-22A1/2, and 13N/1W-13P1/2/3. At least once each year, the District will obtain new data for these monitoring wells from DWR's online Water Data Library, and will prepare hydrographs of groundwater elevations in these wells for their period of record. The hydrographs will also show the ground surface elevation. The first set of hydrographs from key wells is included as an Appendix.

RD 108 also makes its own water level measurements using a Powers Portable Well Souder electric water level meter. The measurements are always made from an established reference point. The District makes measurements of water levels in its two irrigation wells in Spring (March or April), Fall (October or November), at the beginning and end of pumping, and at least once per month during the pumping season. The measurements are recorded on a field sheet and are then entered into an electronic spreadsheet. The water level measurements are reviewed during the pumping season to ensure that they the pumps are not in danger of being dewatered, and are charted in hydrographs at least once per year.

#### 4.1.2. Water Quality Monitoring

The District has purchased a waterproof portable water quality meter (HANNA Instruments Model 991301), which is used to make field measurements of pH, specific conductance, total dissolved solids, and temperature. The instrument is calibrated and operated in accordance with the manufacturer's instruction manual. The District measures specific conductance, pH, and temperature in its two production wells at the beginning and end of pumping and at least once per month during the pumping season. Measurements are recorded on a field sheet and are then entered into an electronic spreadsheet. Specific conductance is used as an indicator of overall water quality. The District reviews specific conductance measurements during the pumping season to ensure that there is no degradation of water quality, and charts of specific conductance over time are prepared at least once per year.

The District also obtains water quality samples from its production wells approximately once every five years, and conducts laboratory analysis for general mineral content, arsenic, manganese, and nitrate.

In addition, at least once per year the District reviews land use in the immediate vicinity of its production wells to identify activities that could contaminate the wells.

#### 4.1.3. Land Subsidence Monitoring

The Sacramento Valley Height-Modernization Project (SVHMP), spearheaded by DWR, established GPS survey monuments where land surface elevation can be measured and recorded over time to identify inelastic land subsidence. The project includes 337 survey monuments in 10 counties, and the first survey was completed in 2008. Seven of these monuments are located within RD 108. RD 108 participated in the effort by providing staff to assist with surveying. The SVHMP network incorporated previous monuments that were established in 1999 as part of the Yolo County Subsidence Network. These include five of the seven survey monuments in RD 108, which were first surveyed in 1999. Surveys of the SVHMP network are planned to be conducted every three years.

No extensometers are located within RD 108, although DWR's Zamora extensometer is located approximately 2 miles south of the District's southern boundary. Figure 6 shows the location of the SVHMP stations in and around RD 108, and the Zamora extensometer.

The District maintains approximately 120 miles of irrigation canals, which distribute water by gravity to District landowners. This distribution system is very dependent on adequate freeboard, which is reduced by inelastic land subsidence. When District

operators notice a problem with any canal section (including low freeboard, cracking, or any other damage or operational concern) they complete a work order form describing the problem. In addition to the formal monitoring described above, this process functions as an additional form of land subsidence monitoring, and is performed throughout the irrigation season.

4.1.4. Groundwater/Surface Water Interaction Monitoring

To evaluate the interaction between groundwater and surface water, and to determine if there are changes in surface flow and surface water quality that directly affect groundwater levels or water quality or are caused by groundwater pumping, it is necessary to have surface water flow and quality monitoring in very close proximity to groundwater monitoring. This does not currently exist in RD 108. Until better monitoring becomes available, the District will use its “key” multiple-completion monitoring wells to evaluate changes in the vertical gradients among aquifer zones. The District will monitor groundwater levels and groundwater quality as described in previous sections, which will allow changes over time to be tracked.

4.1.5. GPS Locations

RD 108 has purchased a Trimble Geo XT, 2005 Series, Pocket PC for use in obtaining Global Positioning System (GPS) locations of wells and other infrastructure within the District. The unit’s accuracy depends on the time tracking satellites, and is generally better than 30 cm. The District operates the unit in accordance with the manufacturer’s instruction manual.

4.2. Action Plan

RD 108 has worked and will continue to work diligently to achieve its Basin Management Objectives. To do this, RD 108 has identified specific actions that will be undertaken on a defined schedule to ensure progress continues to be made toward meeting the BMOs. These actions have been separated by BMO and are described below.

4.2.1. Actions to Involve District Landowners and Stakeholders

To involve district landowners and stakeholders, the District has taken and will take the following actions:

<i>Action</i>	<i>Frequency</i>	<i>Status</i>
Establish and maintain a contact list of interested landowners and outside stakeholders.	Ongoing	<b>Completed</b> ; updated on an ongoing basis.

<i>Action</i>	<i>Frequency</i>	<i>Status</i>
Form a Groundwater Task Force of landowners and stakeholders who are interested in being involved in groundwater management.	Ongoing	<b>Completed;</b> initially formed in 2006.
Establish an RD 108 website.  <a href="http://www.rd108.org/">http://www.rd108.org/</a>	N/A	<b>Completed</b> in 2008.
Notify Groundwater Task Force members regarding current issues related to groundwater via email and regular mail.	When significant developments occur.	Ongoing
Conduct at least one Groundwater Task Force meeting per year that is advertised and open to the public.	Yearly	Ongoing
Provide summary of groundwater conditions with regard to: groundwater levels, groundwater quality, inelastic land subsidence, and water year type.	Yearly at Groundwater Task Force meeting.	Will begin in 2008.
Provide information on groundwater management activities.	Yearly at Groundwater Task Force Meeting; summary at District annual meeting.	Will begin in 2008.
Prepare annual "Manager's Year in Review," summarizing the past year's groundwater activities.	Yearly	Will begin in 2008.
Publish groundwater information on the RD 108 website.	As information becomes available; at least once per year.	Will begin in 2008.

<i>Action</i>	<i>Frequency</i>	<i>Status</i>
Maintain relationships with state and federal agencies.	Ongoing	Ongoing
Participate in regional groundwater management efforts.	Ongoing	Ongoing

4.2.2. Actions to Monitor and Study Groundwater

To monitor and study groundwater, the District has taken and will take the following actions:

<i>Action</i>	<i>Frequency</i>	<i>Status</i>
Install flow meters on RD 108 production wells.	N/A	<b>Completed.</b>
Purchase water level sounder and water quality meter.	N/A	<b>Completed</b>
Purchase GPS unit for use in locating wells.	N/A	<b>Completed</b>
Locate irrigation and monitoring wells within RD 108 and prepare a GIS base map showing the locations.	N/A	<b>Completed.</b>
Cooperate with DWR in its monitoring efforts.	Ongoing	Ongoing since 1995.
Measure water levels in RD 108 production wells.	Spring; Fall; at the beginning and end of pumping and at least once per month during pumping season.	Measurements have been made since 2003; increased measurement frequency beginning 2009.
Select “key” monitoring wells that will be used to evaluate groundwater levels over time.	Reevaluate every year.	Completed; wells selected in 2008.

<i>Action</i>	<i>Frequency</i>	<i>Status</i>
Make field measurements of temperature, pH, and specific conductance in RD 108 production wells.	At the beginning and end of pumping and at least once per month during pumping season.	Measurements have been made since 2003.
Take samples from RD 108 production wells and conduct laboratory analysis for general mineral content, arsenic, manganese, and nitrate.	Approximately every 5 years.	First analysis in 2003.
Identify projects and studies that would help further monitoring and understanding groundwater; apply for grants to fund studies.	Ongoing	Applied for grants in FY 00/01, 01/02, 02/03, 03/04, and 07/08.
Maintain a record of the amount of groundwater pumped from RD 108 production wells.	Ongoing	Measurements have been made since 2003.

4.2.3. Actions to Avoid Groundwater Overdraft

To avoid groundwater overdraft, the District has taken and will take the following actions:

<i>Action</i>	<i>Frequency</i>	<i>Status</i>
Review water levels in RD 108 production wells during the pumping season.	At least monthly during pumping season.	Ongoing since 2003.
Plot water levels in the “key” monitoring wells on charts to track changes over time.	At least once per year before start of pumping season.	Ongoing since 2008.
Review land subsidence data.	At least once per year before start of pumping season.	Will begin in 2008.

<i>Action</i>	<i>Frequency</i>	<i>Status</i>
Obtain water year type for the Sacramento Valley.	Yearly	Ongoing.
Use appropriate hydrogeologic principles to determine whether water level data from “key” monitoring wells shows that groundwater conditions show signs of overdraft.	At least once per year after Spring water level measurements are available.	Ongoing since 2008.

4.2.4. Actions to Avoid Water Quality Degradation

To avoid water quality degradation, the District has taken and will take the following actions:

<i>Action</i>	<i>Frequency</i>	<i>Status</i>
Review specific conductance in RD 108 production wells during the pumping season.	At least monthly during the pumping season.	Ongoing since 2003.
Plot specific conductance on a chart to track changes over time.	At least once per year before start of pumping season.	Ongoing since 2008.
Review land use around RD 108 production wells to identify potentially contaminating activities.	At least once per year before start of pumping season.	Ongoing since 2008.
For new District wells, check that well designs do not connect aquifers with significant differences in water quality.	As needed when new wells are planned.	Ongoing since 2008.
Avoid use of high-salinity aquifers.	Ongoing	Ongoing since 2008.

4.2.5. Other Management Actions

In addition to actions specifically related to the BMOs, the District will take the following actions related to groundwater management:

<i>Action</i>	<i>Frequency</i>	<i>Status</i>
Update GMP Action Plan and implementation status.	Yearly, prior to Groundwater Task Force meeting.	Completed for 2008.
Accept and keep a record of groundwater-related concerns and complaints from District landowners and outside stakeholders.	Ongoing	Ongoing; began keeping records in 2008.
Review whether GMP and BMOs are still appropriate.	Yearly	Complete review conducted in 2008.
Update GMP and BMOs.	As needed based on yearly review.	Most recent update completed in 2008.
Work with Groundwater Task Force to determine if additional groundwater management actions should be taken.	As needed based on yearly review.	Will begin in 2008.

**REFERENCES**

California Department of Water Resources, California's Groundwater, Bulletin 118 Update 2003.

Lower Colusa Basin Conjunctive Use Investigation, DWR, July 1997.

Reclamation District No. 108, Groundwater Management Plan, February 1995 and November 2006.

Reclamation District No. 108, Groundwater Substitution Monitoring, DWR, July 2004.

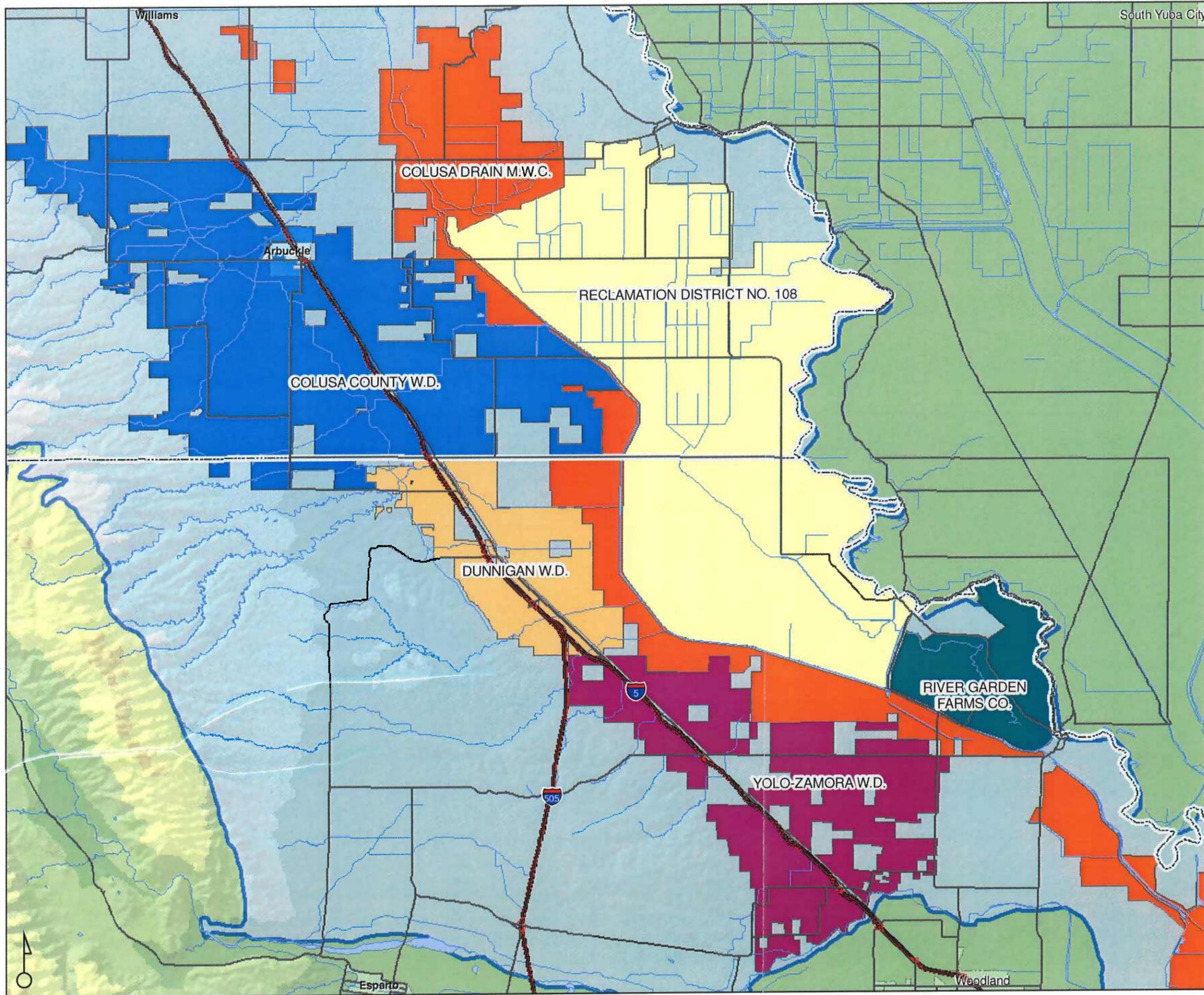
Sacramento River Basinwide Water Management Plan, October 2004.

Yolo County GPS Subsidence Network Recommendations and Continued Monitoring, March 2006.

Investigation of Supplemental Water Supplies for Reclamation District No. 108, Gianelli and Murray Consulting Civil Engineers, February 1963.

Report on Additional Supplemental Water Supplies for Reclamation District No. 108, Laugenour and Meikle and Blackie, April 1973.

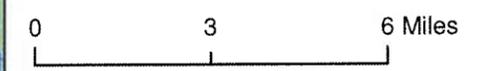
Lower Colusa Basin Integrated Groundwater and Surface Water Model (LCBIGSM) Analysis of Conjunctive Use Projects in the Yolo Zamora Area, Wrieme, July 2003.



### Legend

- Water Districts**
- Reclamation District No. 108
  - Colusa County W.D.
  - Colusa Drain M.W.C.
  - Dunnigan W.D.
  - River Garden Farms Co.
  - Yolo-Zamora W.D.
- Groundwater Subbasins**
- Colusa Subbasin

Sources: ESRI, CaSIL

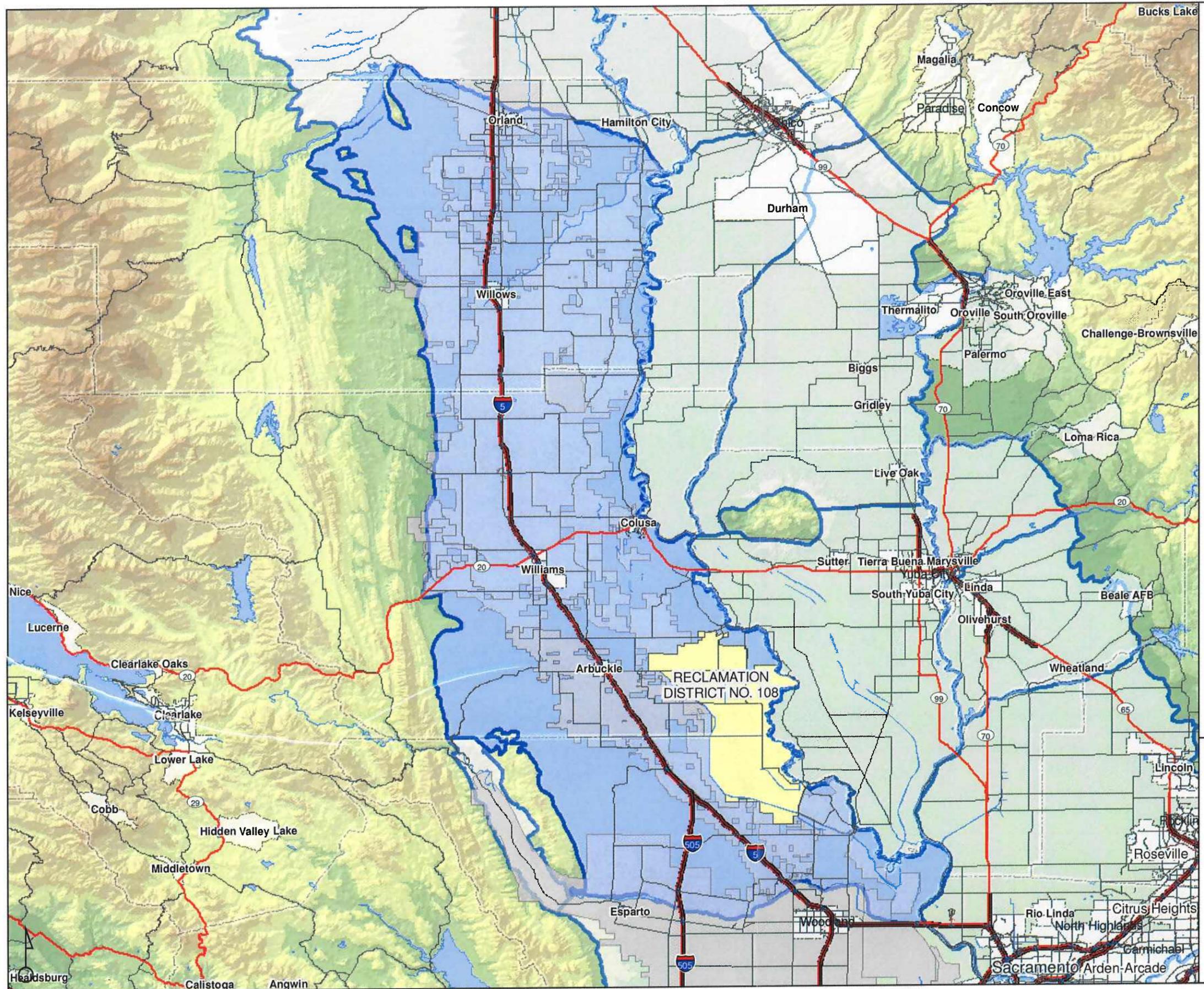


**RECLAMATION DISTRICT NO. 108  
GROUNDWATER MANAGEMENT PLAN**

Figure 1 - Location Map

November 2008





### Legend

#### Sacramento Valley Groundwater Basin

- Colusa Subbasin
- Other Subbasin

#### Water Districts

- Reclamation District No. 108
- Other Water District in Subbasin

Sources: ESRI, CaSIL

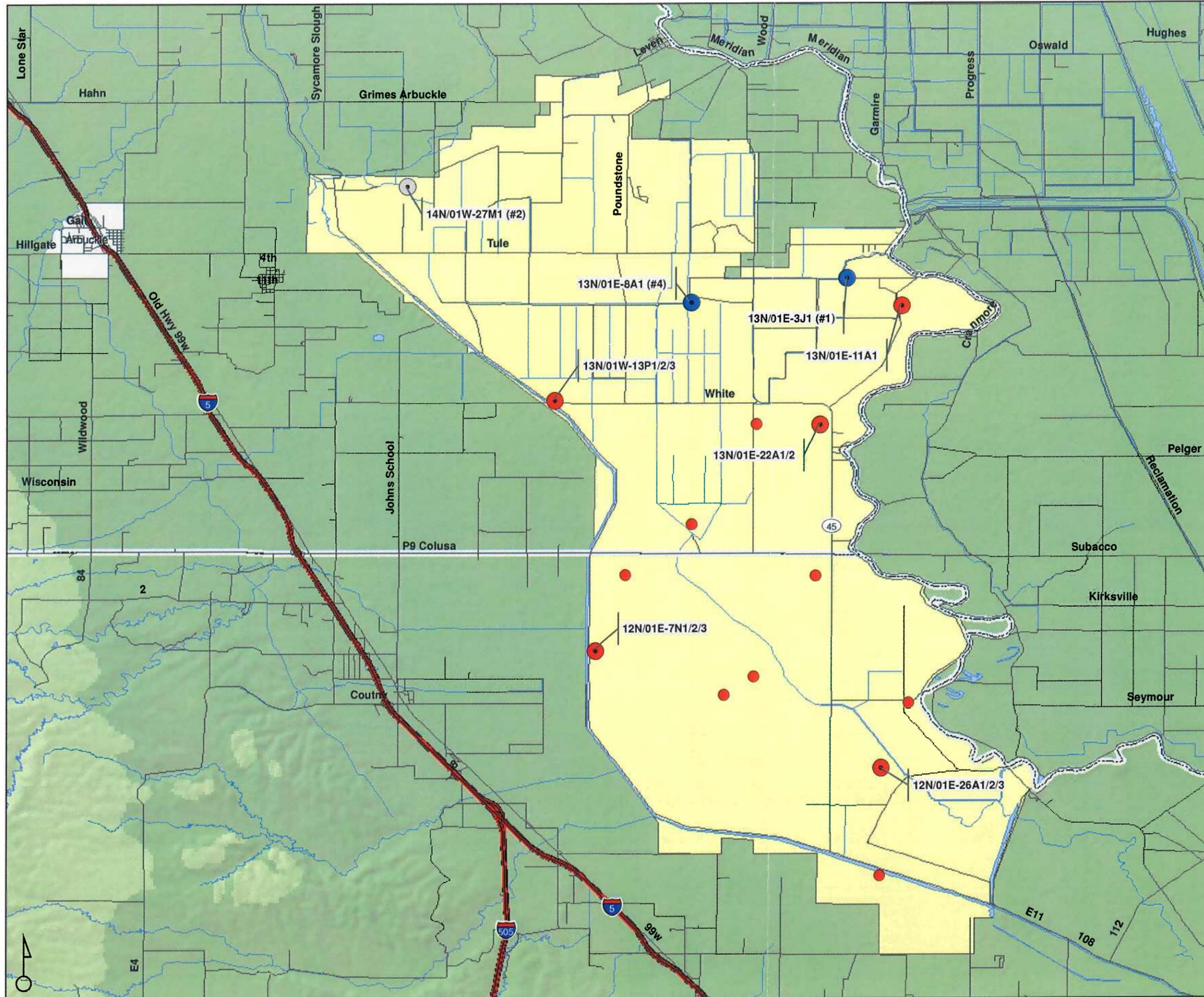


### RECLAMATION DISTRICT NO. 108 GROUNDWATER MANAGEMENT PLAN

Figure 2 - Colusa Subbasin Map

November 2008





## Legend

### District Production Well

- District Well
- Historic Well (No Longer a District Well)

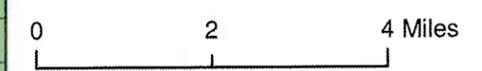
### Monitoring Wells

- "Key" Monitoring Well
- Other Monitoring Well

### Water Districts

- Reclamation District No. 108

Sources: ESRI, CaSIL



## RECLAMATION DISTRICT NO. 108 GROUNDWATER MANAGEMENT PLAN

Figure 3 - Well Locations

November 2008



Figure 4 - Groundwater Elevation  
RD 108 Monitoring Well 13N/01E-11A

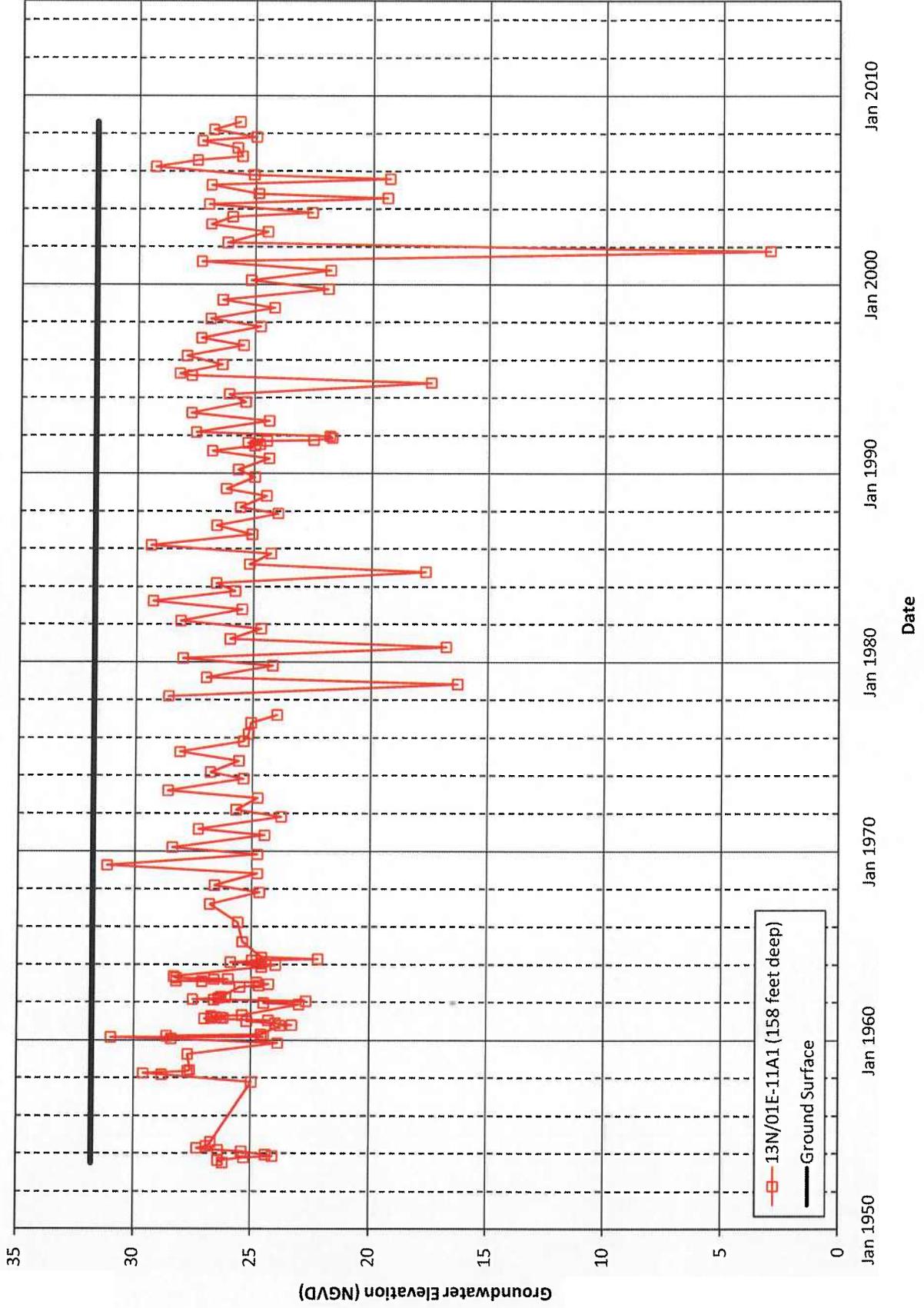
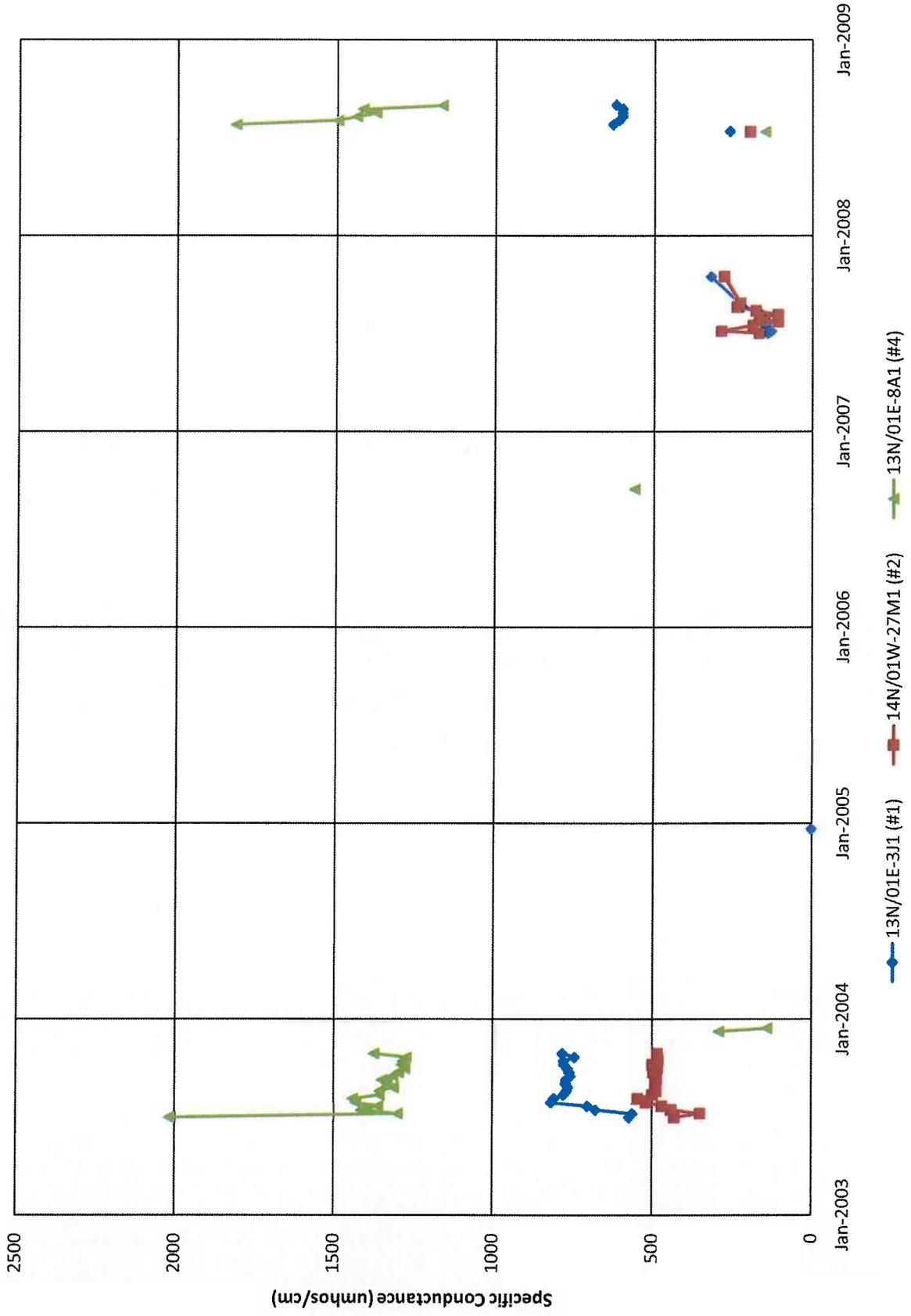
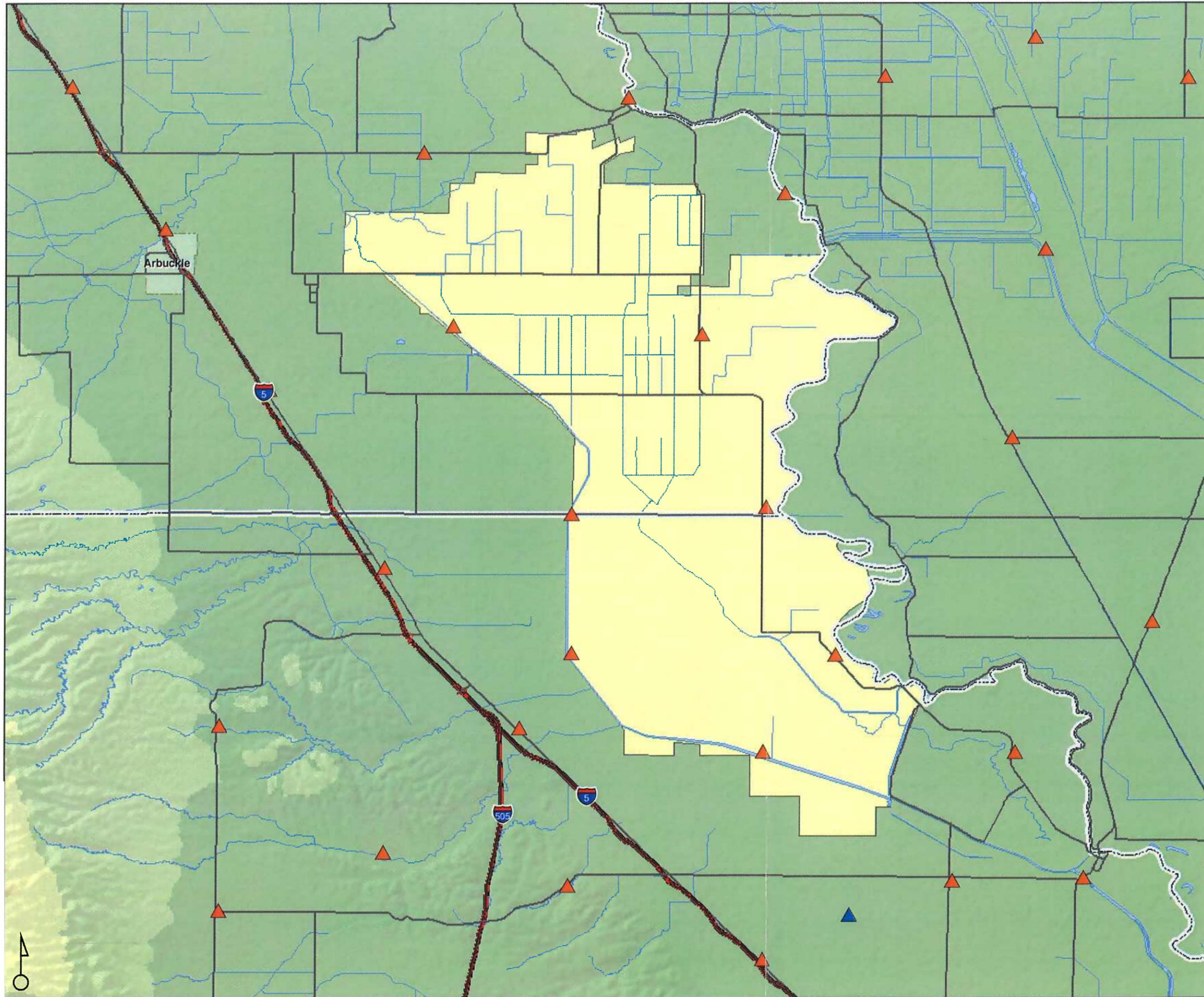


Figure 5 - Specific Conductance in RD 108 Production Wells

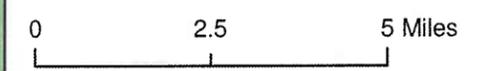




**Legend**

- ▲ Zamora Extensometer
- ▲ SVHMP Survey Monument
- Reclamation District No. 108

Sources: ESRI, CaSIL



**RECLAMATION DISTRICT NO. 108  
GROUNDWATER MANAGEMENT PLAN**

**Figure 6 - Subsidence Monitoring**

November 2008



**TABLE 1 – RD 108 MONITORING WELLS**

<i>State Well Number</i>	<i>Completion Interval (feet below ground surface)</i>	<i>Type</i>	<i>First Measurement Date</i>	<i>Measurement Frequency</i>	<i>Note</i>
11N/01E-2D1 11N/01E-2D2 11N/01E-2D3	610-680 400-410 170-180	Monitoring Well	10/1996	Quarterly to Monthly	
12N/01E-3R1 12N/01E-3R2 12N/01E-3R3	750-760 560-570 330-340	Monitoring Well	6/2000	Quarterly to Monthly	
12N/01E-6D2 12N/01E-6D3 12N/01E-6D4	710-720 485-495 275-285	Monitoring Well	9/1997	Quarterly to Monthly	
12N/01E-7N1 12N/01E-7N2 12N/01E-7N3	700-710 420-430 280-290	Monitoring Well	9/1997	Quarterly to Monthly	Key Well
12N/01E-14R1 12N/01E-14R2 12N/01E-14R3	525-535 360-370 230-340	Monitoring Well	7/1998	Quarterly to Monthly	
12N/01E-16A1 12N/01E-16A2	695-705 420-430	Monitoring Well	9/1997	Quarterly to Monthly	
12N/01E-20A1 12N/01E-20A2	575-585 370-380	Monitoring Well	9/1997	Quarterly to Monthly	
12N/01E-26A1 12N/01E-26A2 12N/01E-26A3	600-670 400-480 255-265	Monitoring Well	10/1996	Quarterly to Monthly	Key Well
13N/01E-11A1	158 feet deep (no other info)	Domestic Well	7/1953	Semiannual to Quarterly	Key Well
13N/01E-21B1 13N/01E-21B2 13N/01E-21B3	665-675 313-323 130-140	Monitoring Well	3/1999	Quarterly to Monthly	
13N/01E-22A1 13N/01E-22A2	670-680 410-490	Monitoring Well	10/1999	Quarterly to Monthly	Key Well
13N/01E-32K1 13N/01E-32K2 13N/01E-32K3	620-630 455-465 245-255	Monitoring Well	9/1997	Quarterly to Monthly	
13N/01W-13P1 13N/01W-13P2 13N/01W-13P3	865-875 410-470 271-281	Monitoring Well	3/1999	Quarterly to Monthly	Key Well

## Appendix A

## APPENDIX A

### RESPONSE TO GROUNDWATER TASK FORCE COMMENTS ON DRAFT 2008 GMP UPDATE

On Wednesday, November 12, 2008, RD 108 held a Groundwater Task Force meeting to discuss the draft 2008 GMP update. The Groundwater Task Force members were provided with copies of the draft 2008 GMP update in advance of the meeting. The Groundwater Task Force recommended that the 2008 GMP update be forwarded to the RD 108 Board of Directors for approval, with the following comments, which are discussed below.

**Comment #1:** An annual “Manager’s Year in Review” should be added to the GMP and should be prepared as an annual update. The Manager’s Year in Review should assess the past year’s groundwater activities and provide a brief update summary for the year.

**Response:** A 2008 Manager’s Year in Review was added to the GMP, and annual preparation of the Manager’s Year in Review was added as an action item under Section 4.2.1 of the GMP, *Actions to Involve District Landowners and Stakeholders*.

**Comment #2:** In Section 1.5.3, the statement that “overdraft is not a problem within RD 108” is probably overreaching. The Groundwater Task Force thought this statement should be conditioned with the subsidence impact that has occurred in the southern portion of our District, i.e. the loss of canal freeboard.

**Response:** Section 1.5.3 was revised to address the issue of “mitigation of conditions of overdraft” separately, and to add reference to inelastic land subsidence in the Zamora area and loss of canal freeboard in the southern portion of the District. In Section 2.2.2 *Groundwater Conditions*, discussion of the loss of canal freeboard was added, and information on subsidence at the Zamora extensometer was moved from Section 4.1.3 *Land Subsidence Monitoring* to Section 2.2.2.

**Comment #3:** An additional Appendix should be added that lists annual landowner concerns. This should be updated annually even if it only says, “no concerns.”

**Response:** This Appendix was added. Section 4.2.5 *Other Management Actions* has an action to “accept and keep a record of groundwater-related concerns and complaints from District landowners and outside stakeholders.”

**Comment #4:** The Groundwater Task Force directed the General Manager to notify them regarding current issues related to groundwater. This would include County groundwater planning activities as well as other issues.

**Response:** In Section 4.2.1 *Actions to Involve District Landowners and Stakeholders*, an action was added to “notify Groundwater Task Force members regarding current issues related to groundwater via email and regular mail.” This action will be conducted when significant developments occur, on an ongoing basis.

**Comment #5:** The Groundwater Task Force emphasized the importance of keeping groundwater issues in front of the landowners at the annual meeting and requested that the District’s groundwater activities be a regular agenda item.

**Response:** In Section 4.2.1 *Actions to Involve District Landowners and Stakeholders*, the frequency of the action to “provide information on groundwater management activities” was expanded to include a “summary at District annual meeting” in addition to providing the information at the annual Groundwater Task Force meeting.

**Comment #6:** There was a request that annual rainfall be added to the groundwater level hydrographs, but it was acknowledged that this could be done in the next GMP update.

**Response:** This revision will be made as part of the next GMP update.

**Comment #7:** There was some confusion tracking the groundwater level hydrographs to the monitoring wells. Additionally, it wasn’t clear to Groundwater Task Force members why all the RD 108 monitoring wells were not treated the same and why the District chose to select certain “key” wells.

**Response:** Figure 3 shows the locations of the five “key” monitoring wells in the District, and Appendix C includes hydrographs for these monitoring wells. Table 1 provides a summary of all 13 monitoring wells within RD 108.

The five “key” monitoring wells were chosen so the amount of data that the District needs to review on an ongoing basis is manageable. These wells are distributed throughout the District, so they will provide a good indication of water levels trends in the District. When the GMP is updated, the “key” wells will be reviewed, and changed if necessary so they still represent overall groundwater conditions within the District. DWR maintains data for all the wells it monitors in the District, and hydrographs for all of the wells are publicly available at <http://well.water.ca.gov/>.

## Appendix B

## APPENDIX B

### SUMMARY OF LANDOWNER CONCERNS

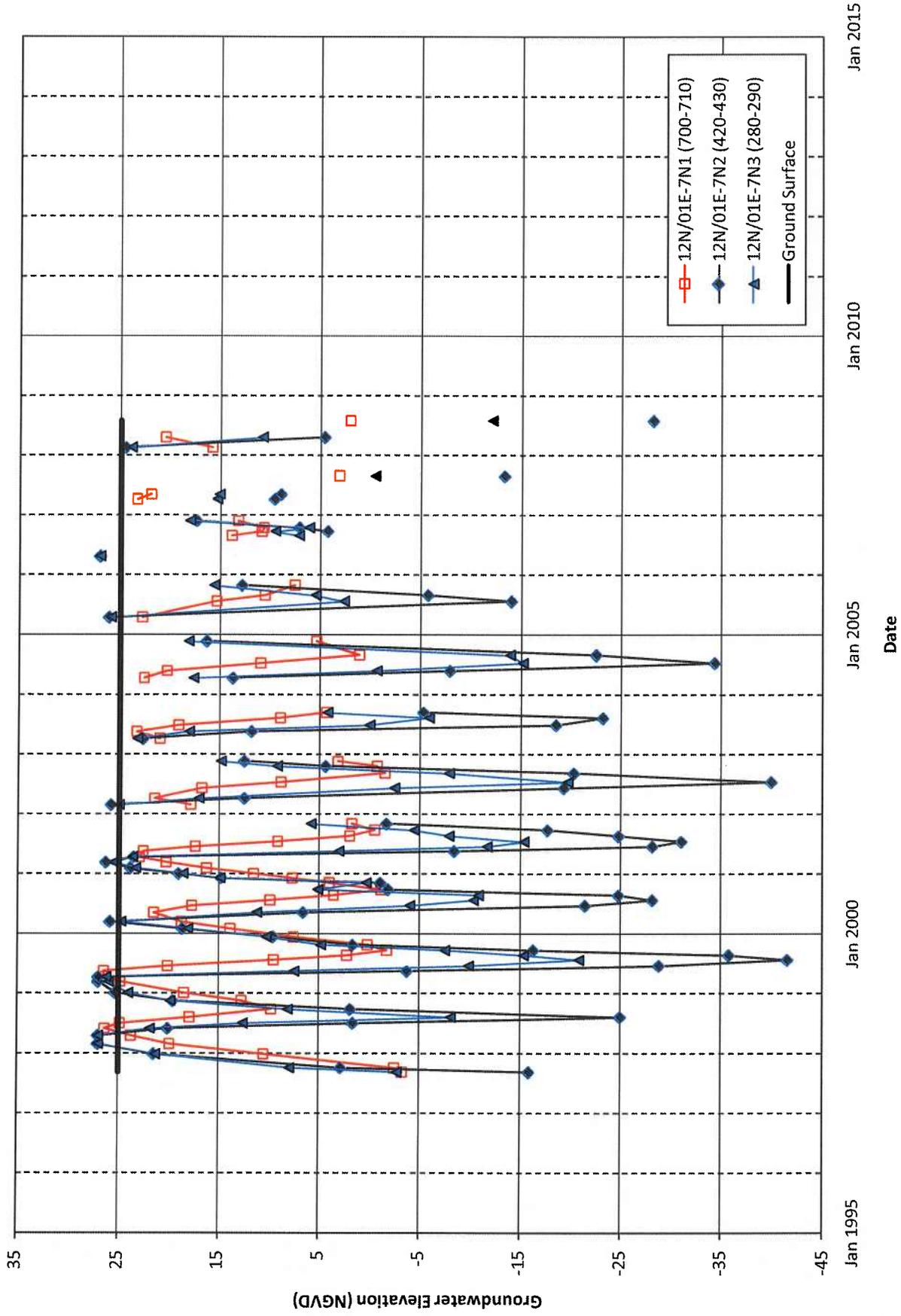
The following landowner concerns and complaints have been received by RD 108.

**2008**

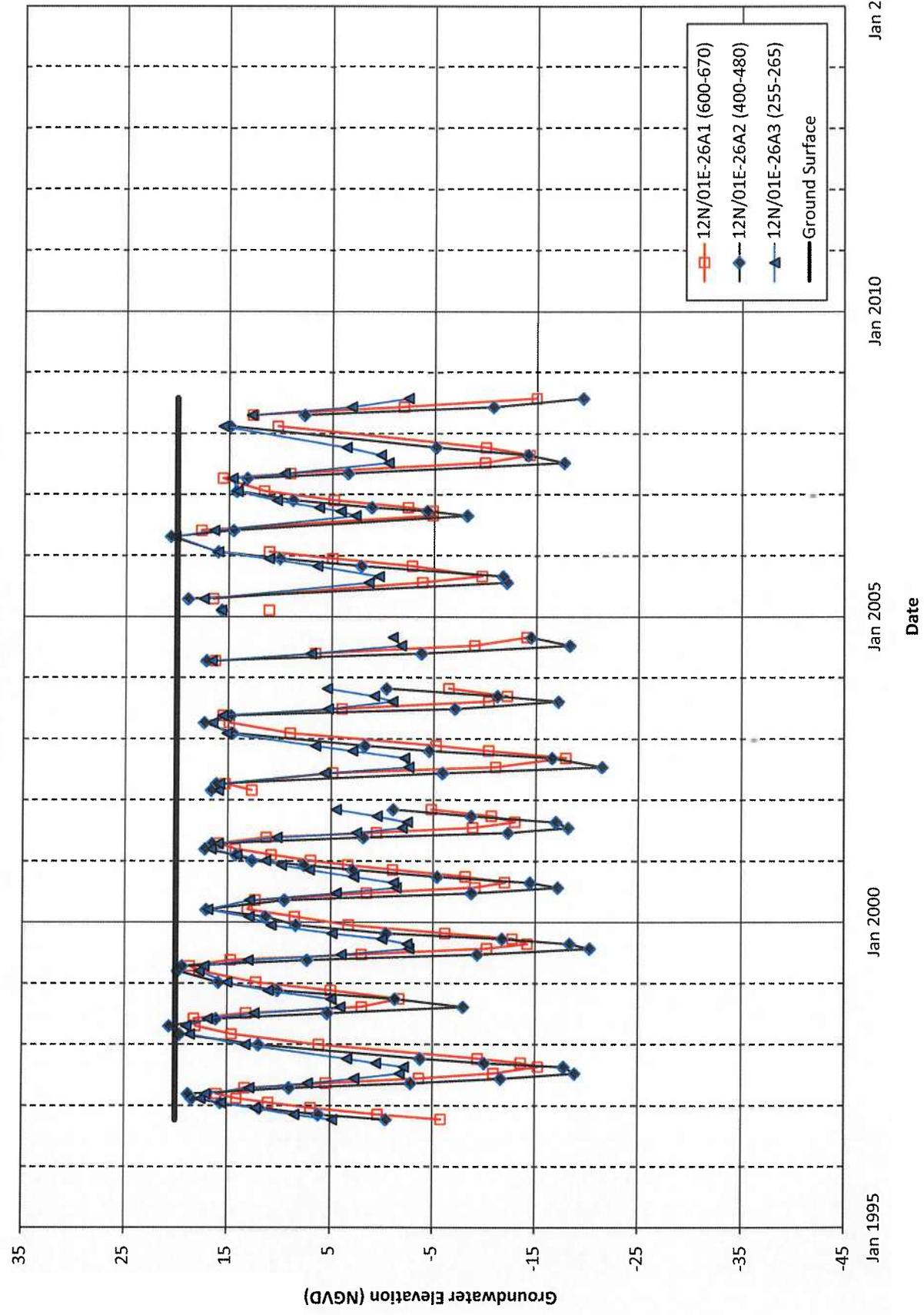
[No concerns/complaints received.]

## Appendix C

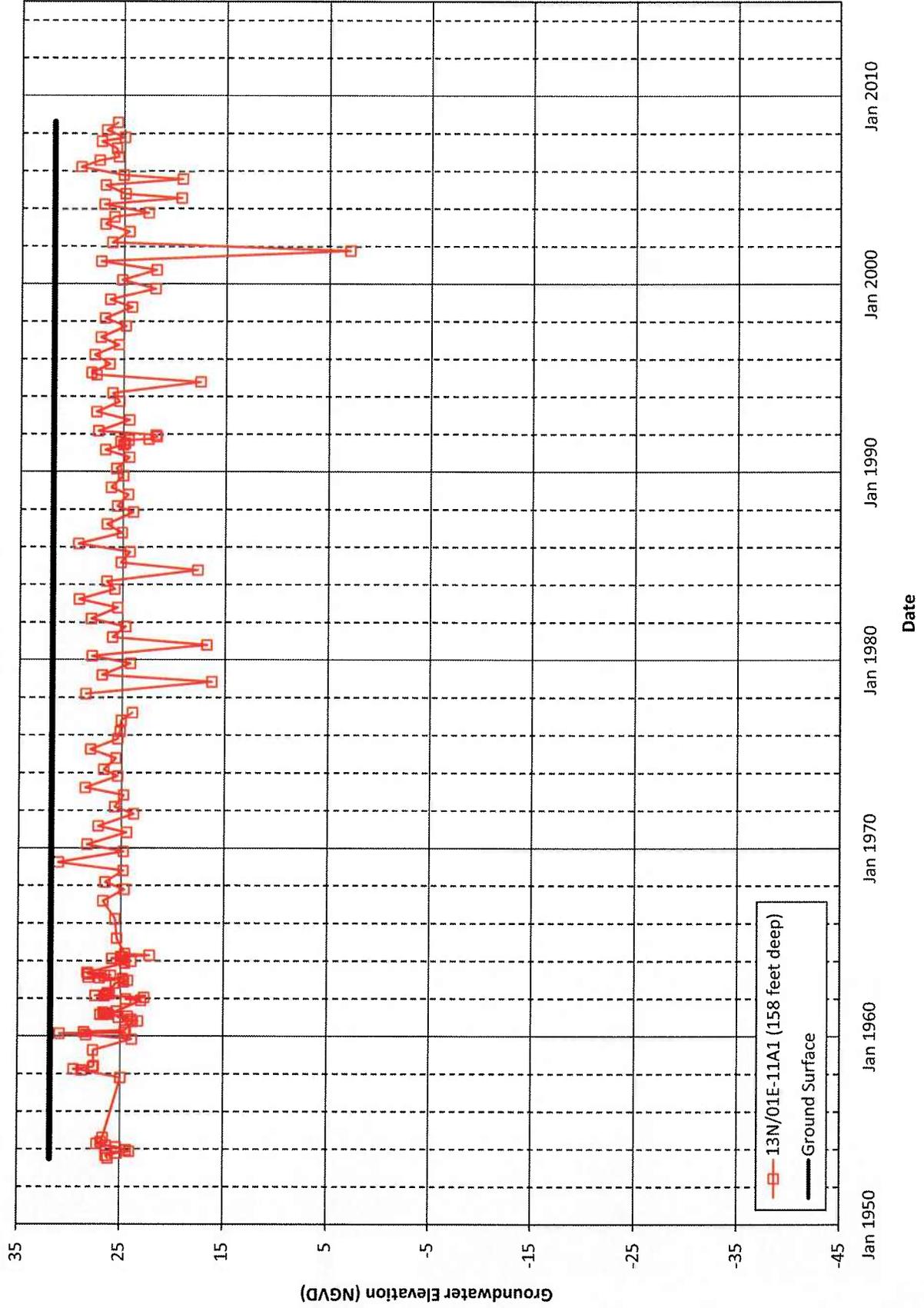
# Groundwater Elevation RD 108 Monitoring Well 12N/01E-7N



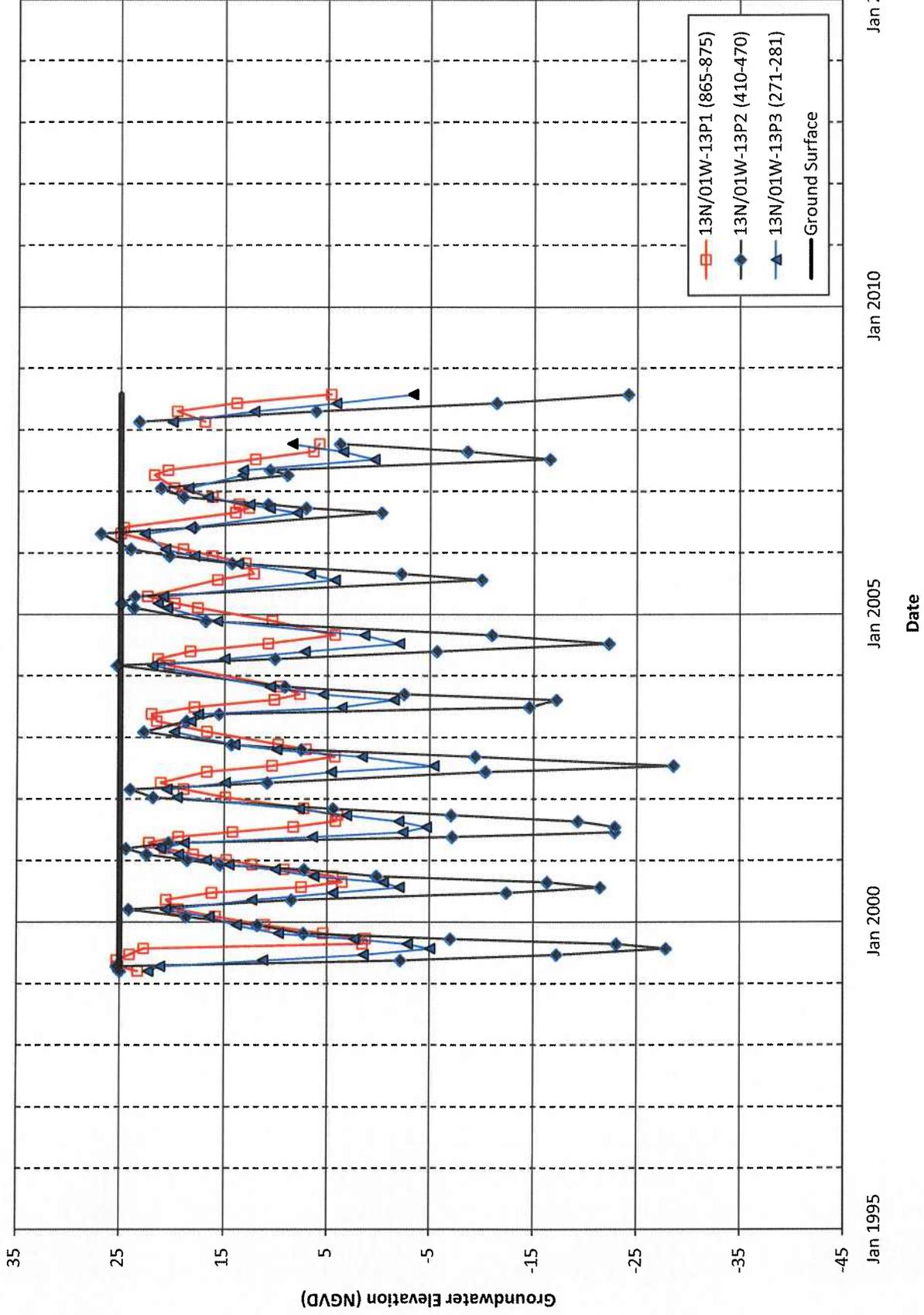
# Groundwater Elevation RD 108 Monitoring Well 12N/01E-26A



Groundwater Elevation  
RD 108 Monitoring Well 13N/01E-11A



# Groundwater Elevation RD 108 Monitoring Well 13N/01W-13P



# Groundwater Elevation RD 108 Monitoring Well 13N/01E-22A

